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THE INDIAN RAILWAY SYSTEM has been augmented by 869 miles built in 1889-90, with 16,095 miles open on March 31, 1890. Of this mileage the State either owns or operates, in about equal proportions, 11,056 miles; guaranteed companies work 3,243 miles, and the remainder is made up of assisted, native and foreign companies, the last aggregating only 58 miles and the first 595 miles. The comparative statement between 1888 and 1889 to Jan. 1 of this year is as follows:

	1889.	1888.
Miles open at end of year	15,831	14,460
Capital outlay on open lines, R*	205,046,009	193,043,257
Number of passengers carried	110,402,383	103,156,013
Number of tons of goods moved	22,155,164	22,393,202
Gross earnings, R*	20,493,633	19,763,475
Working expenses, R*	10,477,401	9,871,347
Proportion of expenses to earnings	50.64%	49.96%
Net earnings, R*	10,116,232	9,890,128
Proportion of net earnings to capital	4.93%	5.12%

* The rupee at present is only worth about 40 cts.

A TEST OF COMPOUND LOCOMOTIVES was made from June to November, 1889, on the Royal Wurtemberg Ry. with 10 new locomotives exactly similar in all respects, save that 5 were simple and 5 compound as regards cylinders. The leading dimensions were:

Grate surface	17.2 sq. ft.	Stroke	22.05 ins.
Steam pressure	176 lbs.	Wheel base	13.123 ft.
Cylinder, diam., simple locom'ive	16.54 ins.	Drivers, diam	64.96 ins.
Compound HP. cyl.	23.62 ins.	Weight, adhesion	30.8 tons.
" LP. cyl.	16.54 ins.	" total	45.1 tons.

The locomotives have 2 coupled driving axles and a pony truck. During the six months the simple locomotives ran 89,283 miles and burnt 2,758,962 lbs. of coal, or 30.9 lbs. per locomotive mile. In the same time and in exactly the same service the compound locomotives ran 88,568 miles and burnt 2,582,474 lbs. of coal, or 29.2 lbs. per locomotive mile. The compound locomotives, therefore, saved about 1.7 lbs. of coal per locomotive mile, or 5.5% of the amount consumed by the simple engine.

GERMAN LOCOMOTIVES FOR ENGLISH ROADS is the text of a late wail from the *Pall Mall Gazette*. This journal says that it understands, "from an authoritative source," that a German firm has captured an order for 17 locomotives for the Metropolitan Railway Company, because they could build them cheaper than English firms.

THE UPPER BERTHS OF SLEEPING CARS in Minnesota must now be kept closed when unoccupied, in accordance with a late decision of the Supreme Court of that State. The decision is in the interest of common sense and better ventilation, and will materially abridge the power of Pullman porters to extort fees and of conductors to exercise arbitrary power, in Minnesota at least. It is an example that could be followed in other States with increased comfort to the traveling public, and the bitter lawsuit that preceded the Minnesota decision has made the way easy.

THE BOSTON ELEVATED RY. will probably be 4.9 miles in length and be operated as an electric road. Pres. WHITNEY of the West End Street Ry., which will build and operate the line, has given an outline of his plans to the Boston newspapers. Mr. THOMAS C. CLARKE, the Chief Engineer, is at work on the elevated structure, and Electrician PIERSON is designing the electrical plant. The elevated and surface lines will have at least three common stations, and it is the intention of the company to give transfers, so that a single fare of 5 cts. will buy a ticket from Dorchester to Malden or Medford.

THE RAILWAY ACCIDENTS OF THE WEEK have been so comparatively few and modest, that it is hard to pick out a "worst" one. The most unusual, and one of the most serious, was due to a land slide over the portal tunnel on the East Tennessee, Virginia & Georgia R. R., Oct. 3. The tunnel was a very short one, through clay, and was not itself injured, the bank above the portal sloughing off enough material so as to completely cover up its mouth. The engineman was killed and fireman injured, and the engine and 5 freight cars badly wrecked. As is apt to be the case with tunnels, the portal was in a cut on a curve and invisible until the train was almost upon it. The tunnel was a very old one, having been built before the war.

THE NEW STEAMER *Plymouth*, of the Fall River Line, made her trial trip on Oct. 1 on the Hudson. She made 25 miles per hour under 125 lbs. steam pressure. The *Plymouth* is 366 ft. long over all, 86 ft. wide over the guards and draws 12 ft. of water loaded. Her engines are double inclined, triple-expansion, of 5,000 I. HP., operating feathering side-wheels.

THE *Sardegna*, Italy's latest war-ship, just launched at Spezzia, is a sister ship to the *Re Umberto*, is built of steel, and has 18 ins. of compound armor. Her dimensions are: Length, 400 ft., breadth, 79 ft. 9 ins.; tonnage, 13,251. A speed of 19 knots is expected. The main battery will consist of four 67-ton guns, eight 15-centimetre, and six 12-centimetre guns. She will also carry ten rapid-fire and machine guns.

TORPEDO BOAT NO. 2 is to be called for by the Navy Department in a few days. The general dimensions alone will be prescribed by the Department; bidders will prepare their own designs. But the boat will be about 150 ft. long, have a displacement of 115 tons, 2,500 HP. and a guaranteed speed of not less than 24 knots. A "torpedo chaser" will also be called for with a displacement of 750 tons and engines of 6,500 HP. and speed of 23 knots.

TWO HIGHWAY BRIDGE FAILURES this week, at Lancaster, Pa., and at Colfax, Whitman Co., Wash., were due to threshing and traction engines, neither causing loss of life. No further bridge disasters are reported.

THE WALNUT ST. BRIDGE across the Schuylkill, in Philadelphia, has advanced sufficiently for the issue of proposals for the erection of the wrought iron approaches, and for bituminous concrete on said approaches. The trestle and masonry piers of these approaches are already practically finished. Proposals will be received by LOUIS WAGNER, Director of the Department of Public Works, until Oct. 27, 1890; blue prints of the plans can be obtained on payment of $5.00.

COMPETITIVE BRIDGE PLANS are called for by the Allegheny Bridge Co. for a structure of two spans, costing not more than $550,000, over the Allegheny River at Sixth St., in Pittsburgh, Pa. This bridge would be the main thoroughfare between Pittsburgh and Allegheny City, and is badly needed. A previously adopted plan with three spans, prepared by Mr. G. LINDENTHAL, has been objected to by the Secretary of War, as interfering with navigation. All plans must be in by Nov. 1, and they should be addressed to WM. ROSENBERG, secretary of the company.

THE NIAGARA FALLS TUNNEL, for water power, was formally commenced on Oct. 4 in the presence of officials of the company.

THE MANCHESTER SHIP CANAL CO. has been authorized by the shareholders to borrow $3,000,000 required for the erection of railways, sheds, warehouses, graving docks and dredges for the canal. These items were not provided for in the original bill, but it has been decided that it was better for the company to control this work instead of letting it to a subsidiary company.

THE MISSISSIPPI RIVER COMMISSION, in its late meeting in New York, elsewhere referred to, made the following apportionment of the $3,200,000 for river improvements, according to the press accounts: For dredging the Mississippi River from Cairo to White River, including Plum Point Reach, $500,000; for the same kind of work from White River to Warrenton, including Lake Providence Reach, $520,000. For the building of levees these amounts were appropriated: Yazoo front, for levees, $300,000; Tensas front, for levees, $500,000; White River front, for levees, $200,000; below Red River front, for levees, $200,000; Greenville harbor, $100,000; for Vicksburg harbor, $75,000; for New Orleans, $100,000; Red and Atchafalaya rivers, $250,000; survey and expenses, $225,000; total, $3,170,000. The commission will report to the Secretary of War, and as soon as he approves the apportionment the work will be begun.

ELECTRICAL SIGNALING DEVICES FOR RAILWAYS have been under thorough test for several years past in France, the purpose being to discover the most efficient means of announcing the passing of railway trains at distant points. Fifty plans have been tested, with the result of only two being selected for further competition. These are the inventions of M. CLEMANDOT and M. BAILLEBACHE. The device of the former is based upon the electrical resistance of two lines of rails according as they are united or not by the wheels and springs of the train. The other device depends on an insulated counter-rail placed at the point at which the moving train starts the signal, and connected by wire with the station.

A COMBINED STREET SWEEPER AND TRANSPORTER has been invented by Mr. E. C. FISHER, an expressman in the Staten Island Ferry house, at the Battery, New York. Over a broom of improved pattern is a bin, and into this the dirt is emptied by a series of revolving buckets operated by the wheels of the machine. The brush is mounted concentrically with the rear axle so that it descends into depressions along with the rear wheels. The sweepings are thrown on an adjustable shield in front of the brush and thence into buckets ingeniously arranged to lift the dirt to the receiving bin. The brush itself is made to contract or expand so as to more thoroughly sweep smaller inequalities in the pavements.

A COURSE IN HIGHWAY ENGINEERING has been practically founded in the Massachusetts Institute of Technology by the acceptance by the executive committee of the late offer made by Col. ALBERT A. POPE, of bicycle fame. Col. POPE proposes to contribute $6,000, which is to be used by the Institute in preparing some graduate, by studies at home and abroad, for the position of instructor and lecturer on this now important subject.

THE ROACH SHIP YARDS, at Chester, Pa., have been finally purchased by English capitalists, and the "Roach Ship Building and Engineering Co., Limited," is now in possession, with a capital of $2,500,000, all of which, excepting about $250,000, is held in England. The Americans interested are Mr. JOHN B. ROACH, President of the Delaware River Ship Building Co.; Mr. GEORGE E. WEED, President of the Morgan Iron Works; Mr. HENRY STEERS, President of the Eleventh National Bank, New York, and Mr. WILLIAM ROWLAND, a capitalist of Philadelphia. There will be seven English directors.

A TRUNK SEWER at Saratoga Springs, N. Y., of 24-in. round vitrified pipe, has a length of 23,119 ft. and a fall of but 1 ft. in 1,000. It was completed in 1887, and has never become clogged or required any repairs.

The New Water Supply of Newark, N. J.

The Passaic water shed of northern New Jersey, called the Central Highland Plateau, is one of the best and largest gathering grounds for water supply on the Atlantic coast. The Passaic River with its own main stream, over 50 miles in length, and its four great tributaries, shown on the accompanying map, the Rockaway, Pequannock, Wanaque and the Ramapo, after a long drought, delivered at Paterson over 126,000,000 galls. per day. During a later freshet, for over ten days its flow measured 11,500,000,000 galls. per day.

The total drainage area above the Great Falls of the Passaic, at Paterson, is 796.9 square miles, or more than twice that of the Croton water shed. If only 12 ins. of the rainfall were saved this area would yield a daily water supply of 457,000,000 galls., about one-third of which is available for high service by gravity.

About 328 cu. ft. per second are required daily for manufactures at Paterson. The storage of the storm waters will, in excess of this amount, leave available a pure and wholesome water supply ample for 3,000,000 of people, allowing 100 galls. per capita daily.

Of the quality of this water the late Prof. COOK, then State Geologist of New Jersey, said: "The streams of the archæan highlands are perhaps the purest of the State. Even after heavy rains they are but slightly turbid, and during the dry seasons their waters are clear, cool and sparkling."

Yet pure as are these upper waters, the lower 20 miles of the Passaic River, below the Great Falls at Paterson, have become little better than a sewer by receiving the surface drainage and sewage of riparian cities and towns with an aggregate population of about 300,000, which is rapidly increasing. The lower cities, however, for many years, have taken their supply from the sewage polluted section of the river, though not without vigorous protests and warnings from sanitarians and a suffering people.

At length there is a general movement to the Highlands for a purer supply. The city of Newark has been the first to secure a better source of supply, and has chosen the Pequannock River, the central tributary of the Passaic, at a point about 30 miles northwest of the city.

The Pequannock rises at the base of the highest summit in New Jersey, about 1,500 ft. above sea level. Its total length is 34 miles, 24 of which are available for high service by gravity. From its source to the point of the Newark intake, it descends 900 ft., or an average of 37 ft. per mile. This rapidity of descent, coupled with the torrential character of its tributaries, tells a wonderful story of aeration and oxidation. Microbes, it is safe to say, do not colonize in such waters. The Pequannock flows across the high land plateau, at the bottom of a rocky clove, amid mountains averaging over a thousand feet above sea level. The soil of the region is shallow, and largely composed of rocky detritus. The section is sparsely populated, and mostly covered with a low growth of forest—a paradise only for knights of the rod and gun. The sharp slopes deliver the rainfall very quickly into the beds of the streams, with only slight absorption, and practically no modification from soluble elements in the soil.

The engineering scheme, under charge of Mr. CLEMENS HERSCHEL, to utilize the Pequannock River is a simple one. It includes a dam and storage reservoir, high up on the main stream, for impounding the head waters; another dam and storage reservoir for impounding the flow of three large ponds and their tributaries north of the main stream, and lower down on the river an intake dam and small distributing reservoir, from which a steel pipe line 4 ft. in diameter and 28 miles in length is to extend to Newark.

The upper dam and reservoir are located at Oak Ridge, on the main stream, about 10 miles from the source of the river and 836 ft. above the sea.

This reservoir will gather the rainfall of about 28 square miles. The water surface will be about two miles long and average one-third of a mile in width, having an area of 417 acres and a storage capacity for some 2,500,000,000 galls. According to the contract, the minimum permissible depth of water in this and the other reservoirs is to be 8 ft., except at the shore slopes. The Oak Ridge dam has great natural advantages for its construction. The river valley narrows between its western hillside and a large prominence of slate rock on the eastern side.

The dam is to extend from this rocky bluff across to the western hillside. Before constructing the dam it was necessary to make a cut through the rock 55 ft. deep and from 30 to 20 ft. wide from the northern side of the rock along a reversed L-shaped course to the bed of the stream below the proposed site of the dam. This miniature cañon is to be the permanent outlet through which the water from the reservoir will be delivered. The gate-house for regulating the outflow is to be in this trench, about 100 ft. from its northern inlet. When it was completed a coffer-dam was constructed across the stream, diverting its flow into the trench and allowing work to begin on the earth dam.

This dam, now being rapidly constructed, is to be 650 ft. long, 45 ft. high, about 500 ft. thick at the base, and 20 ft. at the top, with a concrete core 8 ft. thick, extending from bed rock, at one point 28 ft. below ground level, to the top. The embankments are being built of earth, and the inner one will be riprapped. A wasteway about 400 ft. long is contemplated at what is now the top of the hill east of the rock cut.

It seems improbable that any Conemaugh disaster will ever occur at Oak Ridge.

There is to be no other storage reservoir on the main stream between Oak Ridge and the lower distributing reservoir.

The middle dam and reservoir are to be on one of the northern tributaries of the Pequannock, called Mossman's brook, which joins the river at Newfoundland, 3½ miles east of Oak Ridge.

This brook is the outlet of Buckabear, Cedar and Hanks' ponds, and drains an area of about 10 square miles.

A dam has been begun across this brook, just above Clinton Falls, about 1¼ miles north of the Pequannock River. The natural conditions for construction at this point are even more favorable than those at Oak Ridge. The dam will have to be about 1,500 ft. long to span the Mossman brook valley. The L-shaped trench for the outlet is to be in the rocky hillside at the west end of the dam. The dam will be of earth, 45 ft. high, and again about 500 ft. thick at the base and 20 at the top, affording a full water level about 990 ft. above mean tide level. It will have a concrete core and earth embankments similar to those at Oak Ridge. The water surface area of the reservoir when filled will be about 405 acres, and its storage capacity 3,538,000,000 galls.

Both the Oak Ridge and the Clinton reservoirs are to deliver water only by the natural beds of the streams. Both are situated on the narrow strip of clay and slate formation which lies in the midst of the general gneissic formation of the highland plateau.

MAP SHOWING THE DRAINAGE AREA OF THE PASSAIC RIVER AND THE PIPE LINE OF THE NEW WATER SUPPLY FOR NEWARK, N J.

The middle or intake dam and reservoir, also called the Macopin reservoir, because it receives the outflow of Macopin Lake, is situated on the Pequannock River, east of Charlottesburg, and about 4 miles southeast of the Clinton reservoir. This reservoir, independent of its chief use as a receiving and distributing reservoir, has a drainage area of its own of about 27 square miles. Its estimated storage capacity will be only 30,000 galls., and its water surface area only 13 acres. But it has little value as a storage reservoir, owing to its small capacity, and to the shallowness of its upper portion, due to the

rapid inclination of the river valley where it is situated.

The dam is being constructed in solid masonry from the gneiss rock quarried in the hillside close at hand, and dressed in blocks of large dimensions on the grounds. It will be about 400 ft. long, crossing the river at a slight angle, inclining down stream and founded on a ledge of rock. It will be 15 ft. thick at the base, 8 ft. at the top, and 25 ft. high. The top of the dam will have a waste weir 250 ft. long, allowing the overflow of a stream 5 ft. deep. The constant top level of the overflow will be 590 ft. above mean tide level. The gate-house and beginning of the pipe line will be at the extreme northern end of the dam.

The summary of the Pequannock water supply system is as follows:

Reservoirs.	Elevation above mean tide, ft.	Area.	Estimated storage capacity, galls.	Drainage area, square miles.	Estimated daily yield, galls.
Oak Ridge..	836	417	2,500,000,000	28	22,400,000
Clinton.....	990	405	3,538,000,000	10	8,000,000
Macopin....	590	30	30,000,000	27	21,600,000
Totals.		852	6,068,000,000	65	52,000,000

This reservoir system and the pipe line, described below, the contract cost of which is $6,000,000, is being built with a delivery capacity of 50,000,000 galls. per day. It is estimated that Newark will not require more than 25,000,000 galls. per day in the next 10 years. The city now uses about 14,000,000 galls. per day.

The East Jersey Water Co., which is the contracting party to build the works, in consideration of allowing $2,000,000 of the cost to remain unpaid for 11 years, and in consideration of assuming the cost of care and maintenance during that period, retain the right to use and dispose of the surplus water above 27,500 galls. delivered per day at Newark.

This arrangement would enable the company to furnish an adequate supply from the Pequannock to Jersey City or other adjacent cities and towns, simultaneous with beginning the supply for Newark on the contract time, May 1, 1892, and to continue such collateral supply for at least 10 years, or until additional pipe lines are laid.

Yet these other cities will not be shut up to the Pequannock River as a source of water supply. That is only one branch of the comprehensive plans for utilizing the surplus flowage of the entire Passaic water-shed as formulated and now being developed by JOHN R. BARTLETT, his associates, and their allied corporations, who control the surplus flowage of the water-shed.

The delivery system is one of extreme simplicity. The requirements of the contract are to provide for the delivery at Newark of at least 25,000,000 galls. per day for high service, and at a height of 300 ft. above high water mark in Newark Bay. The other 25,000,000 galls. for low service at Newark must be delivered at a height of 165 ft. above the same mark.

Between the elevation of the intake, 590 ft., and the required highest elevation of delivery at Newark, 300 ft., the difference of 290 ft., covering a distance of 28 miles, allows for an average fall of about 11 ft. per mile. Owing to some unsettled details at the lower end of the line, the profile of elevations is not yet completed. The general route and elevations of the pipe line are sufficiently determined to afford a clear notion of what they are to be.

From the intake dam the line proceeds about one mile along the north bank of the river, then crosses it at about 75 ft. depression below the intake. It then rises by a tunnel beneath the Susquehanna & Western R. R. to the hilly plateau, and bears southeasterly for about 5 miles to Pompton Plains, where it descends from about 540 ft. above tide level to 190 ft., and at that general elevation strikes southeasterly for 10 miles in a direct line to Great Notch, in the Orange mountains, where the elevation is 310 ft. above tide level.

Thence it bears nearly southeast for about 7 miles to the Newark receiving reservoir, and thence by a divergent pipe to the high service reservoir, 5 miles beyond. Between Little Falls and Paterson the pipe will cross the Passaic River on a substantial viaduct. Pipe laying was begun at the Pequannock River crossing on Sept. 20, 1890, and is proceeding thence back toward the intake dam.

The pipe contract is held by McKee & Wilson, of Bethlehem, Pa., who have closed their works there and removed their force to Paterson, at the Vreeland Ave. Station of the New York, Susquehanna & Western R. R. Large buildings have been erected in which to manufacture the pipe. The main building is devoted to punching, beveling, curving, riveting and joining the pipe.

The material of the pipe is open-hearth rolled steel, ¼ in. thick, which arrives at the works from Carnegie's in plain sheets, 7 ft. wide and between 13 and 14 ft. long. Four of these sheets are used to make a 28-ft. section of pipe, weighing about 3,900 lbs. Thicker steel is to be used in the lower sections where the pressure is greatest.

When riveted they are transferred to another building, having great tanks of pure boiling asphalt, into which they are dipped, each length receiving two coatings or dips.

On cooling, the coating substantially hardens, and the lengths of pipe are transferred to platform cars and sent up the river on the New York, Susquehanna & Western R. R. Work is kept up night and day, and the pipe is being rapidly delivered along its appointed route. Great ingenuity and difficult work are demanded in getting the sections of pipe, without injury, from the railroad up the hillsides and through the woods to their destined places at the trench.

In laying the pipe, as soon as the bearings are indicated by the engineers, and a section is lowered and adjusted to its place, one man slips inside and, in co-operation with another on the outside of a joint, quickly rivets it, while a small army of Italians with picks, shovels and tamps in a short time have made a solid bed for the pipe and covered it with at least 3 ft. of earth. The adjustment of joints is by lapping without the use of clamps. The longitudinal seams are on the top of the pipe as laid. Abrasion of the asphalt during transportation is remedied at the trench by a coat of B. and P. paint. This consists of asphalt dissolved in bisulphide of carbon, of which the bisulphide evaporates, leaving a coating of asphalt. In cases of light and shifting or of water-bearing soil, the pipe is protected with a thick layer of concrete. Before it leaves the works, each section of pipe is subjected to a test pressure 1½ timas greater than the hydraulic pressure at the point where it is to be laid. The pressure of the Newark terminal of the high service, 286 ft. head, will be 124 lbs. to the square inch, and of other low service, 421 ft. head, 183 lbs.

The volume of the cylinder will be about 500,000 galls. to the mile, so that its entire length will contain nearly one day's supply for the city at the present rate of consumption. Standpipe connections will probably be made at Newark.

The entire process of pipe-laying is rigidly supervised both at the shop and in the field by employés of the East Jersey Water Co.

Wear of Rails in Swiss Tunnels.

In 1884 the Gothard Ry. began a series of experiments, extending over more than 3 years, on the wear of rails in long tunnels as compared with that of rails on open stretches. In order that the loss of weight due to rusting might be accurately determined, spare rails were placed near those to be tested on both tunnel and open lines. The results of the experiments, as given in the *Organ des Eisenbahnwesens*, are shown in the subjoined table:

	Tunnel lines. 7 rails;		Open lines. 18 rails;	
	in track.	at side.	in track.	at side.
Length of tests, years.....	3.64	3.64	3.43	3.43
Travel, million tons.....	62.7	....	50.6	....
Loss in weight, total lbs..	40.2	24.	4.1	1.2
" " annual	.11	6.5	1.2	0.4
Thickness of rust, tot'l ins.	.0102	.0139	.0003	.0007
" " annual.	.0028	.0039	.0001	.0002
Wear of head, total ins ...	.11	....	.0161	.. .
" " annual, ins.	.03	....	.0047	....

In the tunnels the metal cross ties and track fastenings were found to wear away very nearly twice as fast as on open stretches.

In the Arlberg tunnel the rails show an average annual loss in weight of about 2%, and the metal ties lose about 0.6%. The annual loss in weight of the fastenings is as follows: Angle bars, 0.4%; bolts, 1.6%; screw bolts, 0.5%. The total annual loss in weight of metallic permanent way in this tunnel is 1.3%.

In the 1.55-mile Hauenstein tunnel, on the Swiss Central Ry., the steel rails on the track, which has grade of 1 to 38.2, showed a wear in 8 years under a total traffic of 15.95 million tons of 0.197 in. A second set of measurements of the same rails made after 3 more years of use showed that the wear of the head in 11 years under a traffic of 27.17 million tons was 0.394 in. Although no figures are given for the wear on open stretches, it is extremely improbable that it approaches the amount given for tunnels.

English and American Locomotives.

Our lively contemporary, the *Railroad and Engineering Journal*, which has assumed a kind of "Go it, dad; go it, b'ar" attitude in the discussion between this journal and the London *Engineer* on the comparative efficiency of English and American locomotives, closed, so far as we are concerned, in our issue of Sept. 27, makes the following answer to one of the points raised by the *Engineer*, which is so apt and to the point, and withal so amusing, that we cannot forbear quoting it. We may add that we perceived this to be one of several points in which our English contemporary's positions were very vulnerable, as will appear from a quotation given below, but as it is quite useless to carry on a technical discussion with an antagonist who will not even truthfully state the positions and arguments which he is opposing, and as the interest in the subject as a controversial one is entirely confined to the other side of the water, we forbore any other reply to the *Engineer's* statements than to expose its misstatements and suppressions in regard to this journal's position.

The *Engineer*, in its last article, says: "The whole discussion turns on whether a locomotive boiler has to generate more steam in a given time in America than in England," and then makes the statement that "careful experiment has shown that an average performance (of English locomotives) is 500 lbs. of steam per square foot of grate per hour." When the writer says that an *average* performance of an English locomotive is the generation of 500 lbs. of steam per square foot of grate per hour, he exposes his abdomen. The editor of ENGINEERING NEWS is a serious-minded person, and he may inquire what his transatlantic opponent means by the "*average* performance." If it means that all the locomotives on an English railroad evaporate on an average 500 lbs. of water, while in service, it cannot be true. If it means that *some* of the locomotives average that amount of evaporation *while running*, then that performance is considerably below what many American locomotives are doing. We may take the figures we gave last month of the performance of locomotives on the Grand Trunk Ry. The average evaporation reported then was 7.35 lbs. of water per pound of coal. The average consumption of coal was 121.6 lbs. per sq. ft. of grate per hour. Consequently, 893.7 lbs. of water were evaporated per hour per square foot of grate.

During last March, April and May a careful record was kept of the performance of a passenger locomotive on the Hudson River R. R. during 66 runs between New York and Albany, a distance of 143 miles. This road, as most of our American readers will know, is nearly level over its whole length, so that heavier trains can be drawn than on most other roads.* The steepest grade is one of 26 ft. per mile, which is about a mile long.

The locomotive was of the American type—that is, with four wheels coupled and a four-wheeled truck, with 18 × 24-in. cylinders and 70-in. driving wheels, which carried a load of 60,500 lbs. The grate was 72 × 35⅝ in. = 17.68 sq. ft. of area. The trains consisted of 6, 7, 8 and 9 cars. The weights were as follows:

	Pounds.
Engine.....	94,500
Tender (average).....	44,000
Buffet car.....	79,000
Sleeping car.....	83,000
Compartment car.....	94,500
Sleeping car (16 sections).....	95,000
Dining car.....	89,000
Drawing-room car.....	71,000
Weight of 6-car train.....	641,000
Sleeping car.....	63,000
Weight of 7-car train.....	704,000
Sleeping car.....	63,000
Weight of 8-car train.....	767,000
Sleeping car.....	63,000
Weight of 9-car train.....	830,000

There were 36 trains with 6 cars, 19 with 7, 11 with 8, and 1 with 9 cars. [10 to 12 cars of this kind are regularly hauled on some trains of this road.—ED. ENG. NEWS.]

The average consumption of coal for the 66 runs was 49.46 lbs. per train mile, and the average running speed 42.77 miles per hour—consequently the average consumption of coal was 119.6 lbs. per square foot of grate per hour. The coal used on the Hudson River Railroad is of poor quality, which, taken with the heavy loads hauled made the rate of evaporation only 6.18 lbs. of water per pound of coal. Consequently, the average evaporation for the 66 runs of 143 miles each, or a total of 9,438 miles, *was 739.12 lbs. of water per square foot of grate per hour.* The highest average evaporation for one trip was 7.80 lbs. of water per pound of coal, and the lowest 5.38. The highest average speed was 47.93 miles per hour, and the lowest 37.3. With the nine-car train, the engine evaporated an average of 868.29 *lbs. of water per square foot of grate per hour.* To show the influence of load on the rate of evaporation an experiment was made with an engine and tender which was run from New York to Albany

*These low grades do not make so much difference with passenger service as might be inferred, and the trains noted are no heavier than could be and are handled by similar locomotives on very much heavier undulating grades.—ED. ENG. NEWS.]

without a train. It consumed 18.06 lbs. of coal per mile, or more than a third as much as was burned hauling the heavy trains, and *it evaporated 9.19 lbs. of water per pound of coal.*

Or, take the performance on the Baltimore & Ohio R. R. reported in our August number. In the experiments which were made the quantity of water evaporated per pound of coal was not given. If it was as great as the rate of evaporation in the Grand Trunk experiments—and it probably was at least equal to that, as the coal used on the Baltimore & Ohio road is of excellent quality—the engine would have evaporated 1,423.7 lbs. of water per square foot of grate per hour, or nearly *three times* what the *Engineer* says is the *average* performance of English locomotives. What was done on the mountain grade of the Baltimore & Ohio road is not given as *average*, but as *maximum* performance. It takes just about an hour for trains to run up the 17-mile grade from Piedmont to Altamont, and probably that rate of combustion and evaporation is equaled nearly every day on that part of the road. So far as the questions at issue are concerned, the important point is the *maximum* capabilities of the engines. On nearly all our roads the locomotives probably maintain a rate of evaporation as high as that reported on the Baltimore & Ohio line for short periods of time. If they are not able to do this, in railroad vernacular, they will "stick fast," and fail utterly.

Our English contemporary says: "Our locomotives, both passenger and goods, are worked as hard as they can be worked." Now, if when they are so worked they can evaporate only an average of 500 lbs. of water per square foot of grate, they are obviously inferior to American engines, which evaporate nearly twice as much, and on a punch can convert nearly three times as much water into steam as the English engines do.

The *Engineer* says that the discussion thus far shows (1) that American coal is inferior to English coal, and (2) American firemen are not equal to their English brethren. The only reply one can make to this is, perhaps: Some is, or are—whichever is grammatical—and some is or are not. The character of American coals and firemen differ very much from each other, so that it does not seem worth while to make a general comparison, but probably if an English fireman should undertake to fire a consolidation or express engine while running up the grade west of Piedmont on the Baltimore & Ohio, or Altoona, on the Pennsylvania Railroad, he would get an experience he never had before.

The editor of this journal, writing on this same subject some years before this discussion began, thus summarized the facts as to evaporation per square foot of grate in average American practice, from which it will be seen that he was not likely to be very much impressed by the *Engineer's* alleged "average" of 500 lbs., if the word "average" was given the only rational interpretation, as the service average when doing the maximum of work. We may add that we distrust our lively contemporary's figures above, in so far as they appear to show higher evaporations than some 700 lbs. per sq. ft. of grate, a certain error resulting from the assumptions made in regard to average speed, probably. The following quotation is from "The Economic Theory of the Location of Railways," p. 450-451:

> The lowest rates of evaporation occur with the highest rates of combustion, and *vice versa*; and ordinarily it is not possible to evaporate more than 600 lbs. of water per square foot of grate per hour (say 80 lbs. coal × 7½ lbs. evaporation ratio, or 100 lbs. × 6) for any length of time. More may be done, but it cannot be relied on, and 500 lbs. of water per square foot of grate would come nearer to a moderate working maximum.
>
> Then, as the production of steam is 600 lbs. per square foot of grate per hour, and the consumption per horse power per hour is rarely better than 25 lbs., and often much more, we have $\frac{600}{25} = 24$ HP. as the maximum ordinary capacity of 1 sq. ft. of grate area.

Trotting Tracks.

The remarkable trotting records recently made at Independence, Ia., have demonstrated the advantages of the kite-shaped track over the regulation form as regards speediness, every horse that was in the races having beaten its previous record, in some cases by as much as two seconds. It is probable that the success of this kite track will lead to its general adoption in the future, and as the staking out differs somewhat from that of the usual mile course, we give below a plan showing the general shape of a course as designed by Mr. W. B. FASIG, Sec'y Cleveland Driving Park, for which sketch and many details of general practice as to tracks we are indebted to Mr. E. A. BUCK, Editor of the *Spirit of the Times*.

The location of the regulation mile or half-mile course is a very simple affair. Fig. 1 gives the dimensions of the various parts. The first semicircle (of 420.17 ft. radius, or 13° 40') begins 300 ft from the scoring wire and is a quarter mile in length, then comes a straight quarter stretch, another quarter mile semicircle and a homestretch of 1,020 ft. About 49 acres are necessary for such a course with a 65-ft. homestretch and a 40-ft. backstretch, while from 10 to 12 more acres are necessary for stables and other buildings. The half-mile track has two 660-ft. tangents and two 660-ft. semicircles, of a radius of 210.08 ft., or just half that above, making it a 27° 20' curve if 50 ft. instead of 100-ft. chords are used.

The line that is located in this way is a true mile or half mile in length. The hub-board or board placed along the ground to keep the wheel from the fences, is placed just 3 ft. inside this line, so that the course is $2\pi(420.17 - 417.17) = 18.85$ ft. too short at the "pole," or inside of track. This rule about the measured mile being 3 ft. outside the inner edge of the track is universal, no matter what is the length of the course.

The super-elevation of the outer side of the curves is 1 ft. rise in every 10 ft. of width on mile tracks. It is usual to gain half the rise on the tangent at

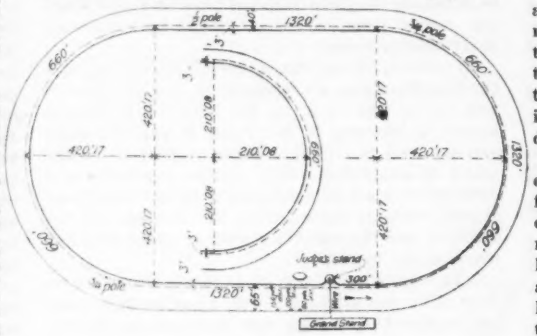


FIG. 1.

the rate of 1 ft. elevation to 20 ft. of tangent, and the remainder on the curves.

The distance stands should be located at the outside of the track, 80, 100, and 150 yds. from the wire. The quarter, half, and three-quarter mile posts should be placed on the inside of the track and similar poles placed on the outside and in a line with the former and the judges' stand, unless the angle deviates too much from a right angle.

Fig. 2 gives all the dimensions necessary for laying out a kite-shaped track like that at Independence, Ia. Of course, the dimensions may be changed somewhat to conform with the available ground, but there should be two tangents of about two-thirds and a single curve of about one-third of a mile. In an Indiana kite track, the small curve for scoring and slowing up is formed by connecting the two tangents, prolonged beyond their intersection, by a small circular arc so that the general shape of the track is that of the figure eight with one loop much

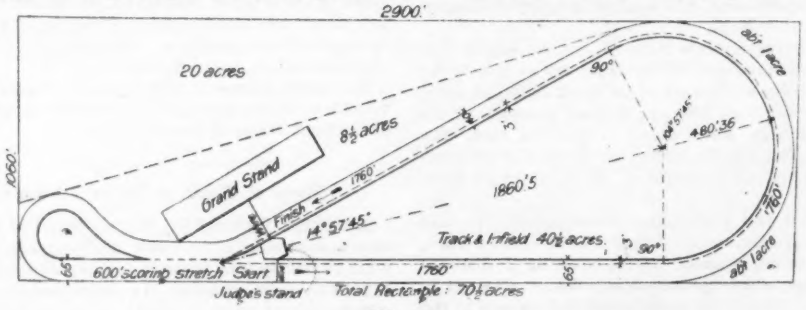


FIG. 2.

larger than the other. Owing to the greater radius of the kite track curve over the regulation form, a super-elevation of 1 ft. in 12 is sufficient.

A track of this kind requires about 70½ acres of land if the total rectangle shown in the cut is wanted. Some 20 acres, of this amount, however, are included in the triangular plot, which can be used as a site for stables and other buildings.

Mr. FASIG sums up the advantages of the kite course as follows.

> In addition to the increase of speed to be obtained by using one turn in place of two, every horse in the race except the one at the pole, would trot a shorter mile [*i.e.*, a less excess over an actual mile.—*Ed.*] than on the regulation track. Assuming the second position to be 6 ft. from the pole—and it is undoubtedly more than that distance—a horse in second position trots 37.7 ft. further than at the pole on the regulation track. On the kite-shaped track, in second position, he trots but 22 ft. further, making a saving of 15.7 ft. It has certainly one disadvantage, that no heat longer than a mile can be trotted upon it.

Concerning the construction of the track itself there is some diversity of opinion. There is little choice between clay, clay-loam, muck or any rich soil that packs readily with little tendency to form hollows. If the soil is naturally sandy, then the roadbed must be covered with a 6-in. dressing of clay or clay-loam, as free as possible from pebbles.

A very slight inclination toward the pole should be given the track, in order that the water may drain off into a ditch placed 2 ft. inside the course, and of at least one square foot sectional area. At intervals of some 25 ft., or more frequently if required by wet places, small gutters should be dug from the inside of the track to the ditch. They must be shallow, especially on the turns, in order that there may be no washing away of the surface.

Many trainers claim that a slight grade is of advantage as resting certain sets of muscles. This is a disputed point. The fast track at Cleveland, O., rises 16 ins. from the starting wire to the first pole, then rises 2 ft. to the ¼ mile pole, then falls 2½ ft. to the three-quarter pole and then falls 10 ins. to the starting wire. Whether the speed of the track is in part due to these grades or to its excellent condition must be left to better judges to decide.

After the track has been once brought into proper condition it will not do to let it take care of itself for 51 weeks in the year if there is ony expectation of having a proper surface the remaining week. It must be plentifully watered by a special sprinkler having wheels with tires 6 ins. wide in order to avoid cutting into the ground. The proper time to harrow the track is after a rain or sprinkling. A track should never be harrowed when absolutely dry, or it will become "rotten," or rough.

One of the most important tools for use on a track is the "float" or "floater." It is a 16 ft. square frame made of 2 × 4 in. scantling, three or more intermediates at regular intervals in order to stiffen the frame. The float is hitched up slightly to one side of the center, so as to carry the surplus dirt dirt and pebbles to the outside. It is said to be the best implement known for keeping a track smooth and free from waves.

The judges' stand should be about 10 ft. from the inside of the track and 300 ft. from the beginning of the first turn on a mile track or 175 ft. on a half-mile track. The position of the grand stand is governed by local circumstances. The end nearer the first turn should be about 15 ft. from the track fence, and the front of the stand should make a slight angle with the track.

The stables should be located together and within easy call of the patrol judges. There should be a box stall for each horse, if possible, for the noise and confusion incident to rubbing down the different animals is apt to make young horses nervous and excited.

In laying out a race track there are so many things to be taken into consideration that the surveyor must be governed to a great extent by local circumstances. The fastest track is undoubtedly the straightaway course already in use for some of the running races in the neighborhood of New York. The two-turn regulation track is the easiest to watch from a grand stand. The kite track requires a large amount of land, but apparently combines the advantages of both the other forms. It is an innovation that has apparently come to stay, and if any reader of ENGINEERING NEWS is called upon to lay out a race track, it would be well to investigate the claims of the kite. There is no doubt whatever that the races on the Independence course have resulted in an astonishing reduction of records; so great a reduction, in fact, that it is likely to be noted hereafter on what kind of track given records were made.

The above comprises about all there is to the art of laying out race tracks, and will answer a number of inquiries which have reached us lately.

Alexander Lyman Holley.*

WITH INSET.

II.

The practical value of the Bessemer process for manufacturing steel had by this time become widely recognized, and it followed almost as a matter of course that HOLLEY, who was always on the lookout for some ne and good thing, felt intuitively that the time for which had so long waited had at last arrived. The story of Bessemer process was at that time no new one. Seven years before, at the Cheltenham meeting of the British Association for the Advancement of Science, Mr. BESSEMER had made the first public announcement of his invention. The title of the paper excited derision,† its reading wild enthusiasm. Mr. JAMES NASMYTH said of the samples shown to the astonished audience, "Here are true British nuggets." A wave of excitement passed over the country; one result of this paper was that almost immediately a sum of $250,000 was offered for the English patents; another, that within a month £28,000 had been paid for licenses to work the process in Great Britain alone. Then swiftly followed a fierce reaction, consequent on failures due to hasty experiments and crude trials. Abuse of the inventor was as hearty as the praise had been fulsome a few weeks before.

The newspapers of the day were unanimous in condemning the process as delusive and useless, and referred to it as "a brilliant meteor that had flitted across the metallurgical horizon, dazzling all beholders for a moment, only to die out and leave no trace behind." As a lasting tribute to the sagacity of the Council of the British Association, I may add that that astute body refused to admit the paper in their published transactions. In the face of terrible difficulties and discouragements Mr. BESSEMER worked steadily on, and in the course of a few years he established works at Sheffield, where the process was still in an experimental stage when HOLLEY first visited them. In a letter I recently received from Mr. W. D. ALLEN, the brother-in-law of Sir HENRY BESSEMER, and who was then, as he still is, the manager of those works, the following appreciative remarks about HOLLEY occur:

> Mr. HOLLEY came to Sheffield in 1864; he was then a bright, intelligent young fellow (he did not look one-and-twenty), genial and open-hearted to a fault. America was never represented by a more perfect gentleman, or one more calculated to win the respect and esteem of all those he came in contact with in this country; indeed the handsome young American not only won our esteem, but our hearts. He came with the intention of gathering what knowledge and facts he could, relative to the Bessemer process of steel-making, and with that view he passed several months at our works, observing and mastering the details of the process, so that I saw a good deal of him, and was associated with him during the greater part of his visit.
>
> He applied himself very assiduously to the object he had in view; was mostly at the works by 9 A. M., and frequently remained till 9 to 10 P. M. to witness some special operation; for I must tell you that at that time our own career was so young that we were frequently occupied in the application of our material to some new and useful purpose. In these experiments Mr. HOLLEY always took much interest.
>
> As regards the process itself he was most enthusiastic, and from the first pronounced it a "grand thing for America;" his desires and aspirations were concentrated upon introducing it into that country, and his efforts were mainly instrumental in doing so.

The Sheffield Bessemer Works in 1864 were on a very small scale; they only comprised two 3-ton converters and a corresponding plant. HOLLEY came from America upon this business as the representative of Messrs. Corning, Winslow & Co., a firm that was afterwards changed to Winslow, Griswold & Holley. His mission was to purchase the Bessemer patents for the United States, to learn the process, and afterwards to inaugurate the new industry at home. He came back successful on all points, and the following year the works at Troy were built.

As is the case with so many great inventions, a number of active minds were turned toward the manufacture of steel, stimulated thereto by BESSEMER'S success and his reputed failures. Prominent among these in the United States was W. KELLEY, of Eddyville, Kentucky, and your talented countryman, Mr. W. F. DURFEE, addressed himself to the practical development of this invention; it was he who constructed the experimental steel works at Wyandotte, Mich. This was in 1862, the year of the great International Exhibition in London, where HOLLEY had ample opportunity of studying the products of the Bessemer converter. We may be certain that what he saw there convinced him of the importance of the process for the United States. His judgment was confirmed by that of ZERAH COLBURN, who, with his usual foresight, had some time before become a strong advocate of the process. Writing in the London *Engineer* in 1862, ZERAH COLBURN said: "The fact, that as a substitute for wrought iron, at least where facility of welding is not of a special consequence, the Bessemer metal is now known to be of established trustworthy character, is of itself a most important one, and as those who fully know the process are aware that ingots can be turned out by it at £6 a ton, and finished rails at less than £10, we have only to await the time when, through competition, this metal has been cheapened to an extent which will insure its general application for the many purposes to which it is so admirably fitted."

When HOLLEY returned to America early in 1864, having purchased the American patents, and learned the process, he and his associates found themselves confronted with the risks of costly litigation. It was claimed that the Kelley patents preceded and covered those of Bessemer, but after some delay this difficulty was removed by compromise. Indeed, on Mr. DURFEE'S own showing, the costly experiment to prove the value of the Kelley patents was really only a test of the Bessemer process. In an interesting paper read before your Society of Mechanical Engineers, in 1884, Mr. DURFEE says with perfect frankness, "I possessed myself of all the information attainable concerning the Bessemer process, and as it was confidently expected that Mr. Z. S. DURFEE would be successful in his efforts to purchase the American patents issued to Bessemer for the various forms of apparatus for the production of steel by the pneumatic method, it was thought only to be anticipating the acquisition of property rights to use such parts of his invention as seemed suited for the purpose." The Wyandotte experiment developed no great results, but for it can be claimed the first production of Bessemer steel in the United States and the first output of steel rails. After the return of HOLLEY to America, in 1864, the Troy Works were started, and the first charge of Bessemer metal was made on Feb. 16, 1865. Let me refer you to Mr. R. W. HUNT'S interesting paper on the original Bessemer steel plant at Troy, read before your Society of Mechanical Engineers in 1884. You will see from it that Troy was only a small works with two 2-ton converters, but such capital steel was produced that enterprise and capital were convinced. During the month of May, 1865, less than 12 weeks after the works were started, 80 charges were made, giving 118 tons of steel with 16.7% of loss; immediately after this the works were extended by the installation of a plant that included two 5-ton converters; Mr. Z. S. DURFEE assumed the charge of the establishment, and HOLLEY proceeded to construct steel works in other parts of the country, commencing with those of the Pennsylvania Steel Co., at Harrisburg.

The thorough efficiency of the Bessemer process having been thus demonstrated, there was no limit to the supply of capital required for the erection of steel works, and HOLLEY rapidly found himself almost unable to satisfy the demands made upon him for designing and starting new establishments. He, however, never knew what it was to have too much occupation, and the finest steel works in your country bear evidence of his skill and industry; those of North Chicago and Joliet; the Edgar Thomson Works at Pittsburg; the Vulcan Works at St. Louis; the Cambria, the Bethlehem, the Scranton and other works were built under his instruction and from his plans. But more than this, HOLLEY completely modified the details of the Bessemer process as he had learnt it in England; he adapted it to the special requirements of the American manufacturer, who was enabled, through the modifications he designed, to produce those stupendous outputs of steel, the records of which were so long received in England with incredulity. This is what the joint inventor of the Basic process—Mr. PERCY C. GILCHRIST—wrote to me upon the subject of HOLLEY'S modifications and improvements.

> "I have the greatest admiration for the work HOLLEY achieved, as I think that the present proud position of the American steel trade is very largely due to his genius. A lesser man would have copied the European steel works, but in stead of this he picked out the weak places, and in the American works that were fortunately subject to his advice one sees how their defects were avoided by him, how breakdowns were eliminated, labor saved, and output consequently increased.
>
> HOLLEY from the very first appreciated the Basic process, and was most kind and generous in his appreciation; he suggested at an early date that the more rapid wear of the Basic lining of the converter should be met by removing the shell of the converter with its worn-out lining from its belt and by replacing it with a fresh shell ready lined; this plan was put into practice by Mr. ARTHUR COOPER at the Northeastern Street Co.'s Works at Middlesbrough, and is giving excellent results.
>
> I regret to say that I saw very little of HOLLEY myself, but my cousin, the late SIDNEY GILCHRIST THOMAS, saw a good deal of him; they had much in common, both in ability, go-aheadness and perseverance, and they had, I know, an intense admiration for each other.

One of your own engineers, Mr. R. W. HUNT, has summarized HOLLEY'S work in this direction; he says: "The result of his thought gave us the present accepted type of American Bessemer plant; he did away with the English deep pit, and raised the vessels so as to get working space under them on the ground floor; he substituted top-supported hydraulic cranes for the more expensive counterweighted English ones; he put three ingot cranes round the pit instead of two, and thereby obtained greater area of power; he changed the location of the vessel as related to the pit and melting-house; he modified the ladle crane and worked all the cranes and vessels from a single point; he substituted cupolas for reverberatory furnaces; and last; but by no means least, he introduced the intermediate or accumulating ladle, which is placed on scales, and thus insures accuracy of operation by rendering possible the weighing of each charge of melted iron before pouring it into the converter. After building such a plant, he began to meet the difficulties of details in manufacture, among the most serious of which was the short duration of the vessel bottoms and the time required to cool off the vessels to a point at which it was possible for workmen to enter and make new bottoms. After many experiments, the result was the Holley vessel bottom, which, either in its form as patented, or in a modification of it as now used in all American works, has rendered possible, as much as any other one thing, the present immense production." Vastly as all these modifications tended to increase the output, I think it is necessary to include one other factor that has helped to obtain such extraordinary results—the perfect organization of the managing engineers and the remarkable efficiency of the American workmen. On this point a prominent English steelmaker wrote to me recently, after a visit he had paid to several of your leading works: "Of course, the output was very large from each pit, and this was attained by great facilities for bringing up and getting away materials, and keeping everything at high pressure. The men, I dare say, are paid well, but it was hot weather when I was there, and they were certainly selling their lives."

But apart from organization and skilled labor, the marvelous growth of production from Bessemer vessels in the United States must be credited to HOLLEY; the 15 years' development may be briefly summed up as follows: In 1865, the output from two 2-ton converters in a month was 118 tons; in 1880, the output from two 5-ton converters was 14,000 tons. In 1856, the Pennsylvania R. R. Co. purchased from Messrs. John Brown & Co 5,000 tons of Bessemer rails at $120 gold per ton; last year the production of Bessemer rails in the United States was about 1,644,000 tons. In the year 1868 the total output of Bessemer steel in America was 8,500 tons; the same year in England it was 116,000 tons. In 1879 your production equaled ours, and from that date has always exceeded it, until the last year it reached the amazing figure of 3,169,643 tons, which was 1,000,000 tons more than that of the United Kingdom. Since the first charge was blown at the Troy works in 1865, there have been produced in America upward of 25,000,000 tons of Bessemer steel. And this is the record of the last eighteen years of HOLLEY'S life.

So the busy years passed, bringing with them a rich, if tardy, harvest of fame to HOLLEY. He continued to be recognized as the one great authority in America on Bessemer steel; in Europe his reputation stood nearly, if not quite, as high. We all remember the prominent part he took in the Centennial Exhibition of 1876; his admirable reports on the iron and steel exhibits of that year, and which were followed by a long and masterly series of articles on the steel works of the United States—a series which unfortunately remained unfinished. Some of us have had the privilege of studying his annual and confidential reports on the steel manufacture of the world. These reports are marvels of technical skill and labor; they attest also the unlimited confidence which he commanded both at home and abroad; in the steel works of Europe, as well as those of the United States. They were the result of periodical visits to England and the Continent, and were, during the last years of his life, prepared solely for the use of the Bessemer Association, with which he had entered into confidential relations. The gates of every steel works in Europe was open to him, and from him no manufacturers' secrets were withheld. It was quite a unique position which he then occupied; one for which his long training, high intelligence, and perfect integrity, absolutely fitted him. Manufacturers knew well that their secrets were safe in his hands; that if they gave him much, he brought still more to them; that his visits were always useful and suggestive, and that the exchange of American experience for their own, never left HOLLEY their debtor. There was also another aspect to these annual visits. Time, hard work, and the cares of a busy life, had never withered the great charm of HOLLEY'S character; but, on the contrary, his personal influence and indefinable power of attraction had increased with years. He was loved as much as he was admired; he was as popular in France, in Germany, and in Belgium, as he was in England or the United States. I could have laid before you to-day proofs of this till you would have wearied of them; you have already heard how the Council of an institution, respected throughout the world—the Institution of Civil Engineers have expressed themselves about HOLLEY, speaking from personal knowledge of him. You have heard what were the sentiments of Mr. ALLEN, in the early days of the Bessemer industry, sentiments which grew warmer with the passing years. Let me read you a few more expressions of opinion from distinguished men in England and the Continent of Europe."

[Here follow letters from Messrs. JAMES RILEY, of the Steel Works of Scotland; E. W. RICHARDS, of the Low Moor Iron Works; Mr. GREINER, of the Société Cockerill; Messrs. Schneider & Cie, of the Le Creusot Works, France; the Directorate of the Ruhrort Steel Co., of Germany, and of the Witkowitz Steel Works, of Austria, all couched in the most appreciative terms, which we are compelled to omit.]

* Address of JAMES DREDGE, Esq., at the dedication of the Holley Memorial Bust.

† On the "Manufacture of Malleable Iron and Steel without Fuel," read Aug. 3, 1856.

Had it been necessary I could have multiplied these evidences of friendship and goodwill tenfold. But I think I have brought you enough evidence of how he was admired and esteemed abroad.

A passing reference should be made to the Thomas Gilchrist process of making Bessemer steel which was brought into prominent notice only three years before the close of HOLLEY's career, at a time when his continued efforts had already broken down his magnificent constitution. The ill-fated Mr. THOMAS in some respects resembled HOLLEY, and they had sufficient subjects of interest in common to create a strong bond of sympathy between them. Always eager to know of what was new and of apparent value, HOLLEY speedily made himself master of the basic process, and passed considerable time with the inventors at the works where the method was in operation. He quickly formed a high estimate of the value of the process, and made preliminary arrangements with Mr. THOMAS for its introduction into the United States. Partly as a consequence of this arrangement, THOMAS visited the States in 1879 and passed some weeks with HOLLEY, inspecting the principle of your steel works. I think that HOLLEY's early death was the sole reason why the Thomas-Gilchrist process is so little employed in the United States; the good opinion that HOLLEY formed at the commencement has been fully justified by its large and successful adoption on the Continent of Europe.

Did time permit, I should like to dwell at much greater length on the brilliant and successful years of HOLLEY's career; the period of an abundant harvest, the seed of which had been sown with toil and judgment so many years before. But I must pass on to review very briefly some of the minor though important incidents that complete the picture of his busy life. The professional honors that were so fully his due fell quickly enough on him during the later years. He was elected President of your Institute of Mining Engineers in 1875; he was Vice-President of your Society of Civil Engineers in 1876; he founded your Society of Mechanical Engineers, of which Society you did me the high honor to elect me an honorary member; in 1877 he became a Member of the Institution of Civil Engineers, a body which we in England are proud to regard as the parent of all the Anglo-Saxon engineering societies. In connection with this election, I think you will be interested to hear the summary of HOLLEY's life and works as told by himself in detailing his qualifications for membership.

"In 1853 he graduated in the scientific department of Brown University; was then for one and a half years under Mr. E. H. CORLISS, locomotive engine builder, and one year under Mr. W. G. HAMILTON in the New York Locomotive Works; from 1856 to 1862 he was engaged partly in the literary branch of the profession, and partly as an assistant engineer in the locomotive department of various railways, and also under Mr. E. A. STEVENS in planning marine machinery. From 1863 to the present time he has been connected with the Bessemer steel and iron manufacture of the United States as follows: In 1863, studied the Bessemer steel manufacture in England; in 1864 to 1865, built and managed the Experimental Works at Troy; in 1865-67, built the 5-ton plant at Troy, and built and managed the Pennsylvania Steel Works and Rail Mill at Harrisburg; in 1868-70, rebuilt and managed the Troy Works (burnt in 1868); in 1871-73, built the Bessemer Works at North Chicago and the Bessemer Works and Rail Mill at Joliet; in 1873-75 built the "Edgar Thomson" Bessemer Works and Rail Mill at Pittsburg, and in 1874-76 built the Vulcan Bessemer Works at St. Louis. From 1871 he has been consulting engineer to the Cambria Iron Co. and the Bethlehem Iron Co., and from 1874 to the Lackawanna Iron & Coal Co.; is present consulting engineer to 10 of the works mentioned, and the construction of their several Bessemer works, and to the Otis Iron & Steel Co. and Springfield Iron Co., in the construction of their Open-Hearth Steel Works. He is a member of the United States Government Board to test iron, steel, etc.

It was early in the summer of 1880 when HOLLEY received the first warning that his career was drawing to a close. Twenty-five years of life at high pressure had told on his constitution, though his energy and magnificent mental powers remained unaffected. Of course he refused to listen to the intimation that nature, nearly exhausted, gave him. He came over to Europe and completed, under considerable difficulties, his usual arduous round of professional duties on the Continent; then he returned to London in July, tired and suffering from the attack of his old enemy, chills and fever. The malady refused to be driven out by the usual remedies, the symptoms became more complicated, and with alarming rapidity his illness assumed first a serious and then a most dangerous form, the worst feature of which was that its characteristics baffled the physicians, and made, as events proved, accurate diagnosis impossible.

For weeks he lay between life and death, and you will recall, as if it were but yesterday, the breathless anxiety with which you awaited the receipt of telegrams announcing his condition. By his own insistance these dispatches were made more hopeful than his condition warranted, for his greatest and constant anxiety was to spare his family and friends as far as possible.

It was my privilege to pass many hours by HOLLEY's bedside during this long period of trial, and if my presence and his knowledge of the constant solicitude of his very numerous friends in London afforded him some consolation, his fortitude, his patience and his calm endurance not only called forth our constant admiration, but taught a lesson I can never forget, an example few of us can hope to follow. It was very long before the faintest ray of hope threw a gleam upon that sick bed, not until after he had been absolutely condemned by the highest medical opinion. I believe that nothing but his indomitable determination, which never flagged, saved his life.

The 18 months' respite he had fought for so valiantly was accorded to him; how well he used them others know better than I. This may be the place to put on record the fact that during his illness he conceived the idea of his last, and one of his most important improvements in the Bessemer process—that of the detachable converter shell. This was patented in 1881, and since his death was purchased by the American Bessemer Association. In England this patent has not found a large application, but, I believe, in the United States it has been extensively introduced and has helped still further to increase the remarkable production of the various steel works he designed and organized. "If I was to die at that time," said HOLLEY, "I wanted to do something to enable me to die with credit."

It was with gratitude and thankfulness that his friends bade him farewell when he started for his homeward journey in the fall of 1880; not fully restored, but still snatched, as it seemed, from the grave. The winter, spring, and the first months of the summer of 1881 he passed with you. Then came the perfected plans for his annual professional European visit, the last he had assured me, twelve months before, that he intended to make—a fatal prophecy. But on that occasion he departed from his usual custom, and relaxation formed a part of his scheme, to insure which his whole family traveled with him

One of the main objects HOLLEY had at heart in planning his European trip of 1881 was the realization of a scheme, the first intimation of which was conveyed to me in the letter I have just quoted; the initiation of this scheme was, I believe, wholly due to himself, and certainly no one could so well understand its great importance. Speaking after an interval of nine years, I may be in error in some details; but I think, that between his return to America, in 1880, and his last visit to Europe the following summer, the idea had occurred to him to bring about closer relations between the members of the engineering profession in England and in the United States. I understand that his proposal was carefully discussed by a joint committee of your societies, and that a magnificent programme of reception was prepared. Then HOLLEY and his friend, Mr. CHAS. MACDONALD, whose eminence as a civil engineer is almost as fully recognized in Europe as it is in America, were asked to act as the delegates of your societies; to convene in London such a meeting as they thought most representative and useful, and to lay before this meeting your proposals, that they might ascertain how such an invitation would be received.

The first meeting, HOLLEY very naturally decided, should take the form of a dinner. The dinner took place. There were but few guests, and to them after the close of dinner HOLLEY unfolded his scheme; told in his eloquent and winning way, how warmly you desired to welcome your brother engineers from London; how no limits would be set to your hospitality; how your factories would be thrown open; your professional experiences and information freely given. But it became at once evident that the scheme was impracticable, and would have to be abandoned.

I am not seeking to blame those gentlemen who thus met HOLLEY's warmth with seeming coldness and chilled his generous enthusiasm. The time had not come. But HOLLEY, in his disappointment, did not perhaps make full allowance for the want of appreciation displayed, and was very sick and weary in his failure, which greatly saddened the few remaining months he was to pass in England. And I know how loudly the echo of his failure resounded through the United States. Thanks to yourselves, the memory of that time was blotted out last year, when you responded so fully to the brotherly invitation sent you by the Institution of Civil Engineers, who you were pleased to say extended to you true hospitality and friendship with both hands. I felt the deepest interest in the result of that invitation, and I strove earnestly in my small way to help to make your visit a success, for I felt that it was a sacred duty which I owed to the memory of our dear friend, to assist in bringing to pass what he had so earnestly longed for. Your visit to England last year was the first fruit of HOLLEY's labor of 1881. Are we not all filled with with the same vain longing that he might be among us now to see the further result of his work; to act as host to the foreign guests now assembled on your shores; to hold us once again by the spell of his eloquence?

The plans which HOLLEY had formed before he left New York, of obtaining rest and change by a European tour, were never carried into execution; probably his habits of continuous work were too strong to be broken up. At all events, while his family set out to complete the programme, HOLLEY remained in England for a while, and then made his accustomed round of the steel works in France, Germany and Belgium. He was back again in England in time to attend and take a part in the meeting of the Iron and Steel Institute.

Now HOLLEY's work was done; his plans for journeying north were only partially carried out, and he returned to London early in November to meet his family. With the mist and gloom of the last days of Autumn began the closing scene of this bright career, saddened by a great and unexpected anxiety and grief. During the visit of his family to Rome, one of his daughters contracted a fever, that developed with alarming symptoms almost as soon as they were reunited in London, and for several weeks she lay a victim to a severe attack of typhoid.

During many weary weeks, when HOLLEY's final illness, which had now taken its fatal hold upon his system, was intensified by anxiety at the alarming condition of one of the three persons to whom his life had been devoted, he found in Sir POLYDORE and Lady DE KEYSER two of the truest and most devoted friends. It was greatly due to their unceasing solicitude that HOLLEY's daughter was restored to convalescence before he was ordered hurriedly to quit England. To obey this order meant separation from his family, for his daughter was unfit to travel. But HOLLEY realized that this was his only chance, and slender as he knew it to be, he did not hesitate for a moment. But he would have refused utterly if Providence had not thrown in his way those two good friends, who, after this lapse of years, still cherish his memory with lively affection, and in whose hands he left his family with full confidence.

HOLLEY left London for the last time a few days before the Christmas of 1881. The sad heroic details of the closing scene you all know well. The widespread sorrow that descended on us with HOLLEY's death like a dark veil, has been lifted by the gentle hand of Time, and, looking back, we are able to see in true perspective the great achievements of his busy life; the work that was left unfinished when death called him. It must have occurred to many of us that, after all, it was better so; better for him to have departed from us while still in the vigor of intellect, than to have lingered until his powers failed and the light of his spirit burnt low. He completed in his lifetime more than enough to fill the record of many ordinary lives, and he remains enshrined in our hearts, brilliant and noble. Can we desire more? Can any one of us hope for so much?

I prefer to remember HOLLEY rather as a man of talent, than of genius; that is, if we accept the strict meaning of the word "genius," and regard it as a special gift of arriving always at a desired aim, by intuition—in two words, "inspired instinct." Talent, on the other hand, depends on high mental training and a perfect command of all the faculties; on a great strength of intellect, and on a peculiar aptitude for being moulded and directed to specific ends and to valuable purposes. Does not this apply in all respects to HOLLEY's mind? His great natural gifts were steadily and systematically trained by self-imposed discipline and by the sterner force of circumstances. Yet if we accept the great philosopher's dictum that genius consists of a power to take infinite trouble, then we must ascribe the gift of genius to HOLLEY in a high degree; for in all things, large and small, no amount of trouble was too great for him, provided that what he did was well done. But genius is nearly always ill-balanced, and the great qualities of one so endowed are generally accompanied by petty weaknesses that only too often make these special gifts a burden to the possessor and to those about him. HOLLEY was great all round; as engineer, as inventor, as journalist, and as orator. Equally great was he in his private life. Admired by all those who were his acquaintances; beloved and equally admired by those who had the privilege to be his friends; a devoted husband and a devoted father; one whose only thoughts in moments of extremity were for others, but never for himself. No; let us ascribe to HOLLEY the highest, the most brilliant talents; but do not place it on record that he was a man of genius, for in so doing we imply the existence of weaknesses that had no place in his great nature.

Your faithful and enduring friendship has found graceful expression in marble and in bronze; in a statue which shall remain to speak to future generations of their great engineer who revolutionized the most important industries of America. But this memorial which you have erected is only the outward and visible sign of the spiritual memorial, set within your hearts; to be kept there sacred through life, and beyond it. Many of you have seen carved over one of the portals of Saint Paul's Cathedral the epitaph of its architect: *Si monumentum requiris, circumspice.* So you must look around you for the monument of HOLLEY. It stretches in a vast and ever-growing network over your country; from east to west; from north to south; wherever railways are, his monument lies beneath you as you travel over the lines of steel. You behold it in the vast piles of buildings devoted to the production and the manufacture of steel. The memorial to his great energy and intelligence is made visible in pillars of cloud by day, and in pillars of fire by night, in your greatest metallurgical centers. The development of your most important mineral resources; the contentment and prosperity that wait upon the vast army of laborers in the field where HOLLEY first broke ground; the wealth that has attended those who were far-seeing and bold enough to support him; to no small extent, the marvelous growth of your great country, that causes us, the slow-moving nations of the Old World, to stand and gaze in wonder. All these great things together compose HOLLEY's monument; so if you seek it, your gaze must not be restricted to narrow limits, such as those that bound the matchless pile reared by our great architect, more than two centuries ago; it must range from the Atlantic to the Pacific, from the Gulf of Mexico to the Arctic Circle. On every piece of Bessemer steel that is converted to the service of the arts and industries in the United States might be engraved the words he used to write upon the many drawings he made in London during his first youthful visit, with such a rapid and unerring hand: "Holley Fecit."

I have completed the work your generosity has imposed on me, and, with all imperfections, this address must stand in the archives of your Societies, to bear testimony to my unfitness for the task. In one respect I feel a full measure of satisfaction; I have brought you from beyond the sea, the proofs of how HOLLEY was esteemed by strangers—a gift of precious pearls of human sympathy, worthy to be laid upon the base of your Memorial Column. Would that they were linked together by a golden cord, instead of being strung upon a thread of baser metal, sublimated from very common clay.

Growth of Manufactures in the United States, 1880-1890.

Taking as a basis the very complete trade reports of 1889 of the leading industries of cottons, woolens, chemicals, paper, agricultural implements, flour, lumber, glass, iron and steel and ship building, *Trade* and *Traffic* makes the following comparison of growth between 1879 and 1889. We tabulate this comparison for greater convenience:

	1879.	1889.	Increase, per cent.
Capital invested....	$1,165,000,000	$1,784,840,000	+ 50
Hands employed....	844,776	1,274,000	50
Wages paid.....	256,795,000	320,689,000	36
Raw material consumed...	1,197,000,000	1,586,000,000	30
Gross production... .	1,774,000,000	2,293,779,000	30

Soda in Portland Cement.

Mr. Bernhofer, an Austrian engineer, says *Engineering*, has recently tried the effect of adding crystallized soda to Portland cement mortar and exposing the same to the action of frost. The mortar consisted of 1 litre of cement, 1 litre of lime, with 3 litres of river sand, mixed with a solution of 1 kilogramme of crystallized soda in 2 litres of water. The experiment commenced at 7.30 P. M. on Dec. 9, 1890, and lasted till 10 A. M. on Dec. 10, a period of 14½ hours. During the night the temperature fell to 31½ deg. below zero, and at the finish of the experiment was still 15¾ deg. below zero (Cent.) at which time the specimens were placed in a hot oven where they remained for three hours. At the expiration of this time it was found the extreme cold had had no disadvantageous effect on the setting of the specimens, and the experimenter accordingly concludes that the addition of soda enables Portland cement to withstand the action of frost.

Apparatus for Removing Paint from Locomotive Driving Wheels.

We illustrate herewith a device in use at the Lake Shore & Michigan Southern shops at Elkhart, Ind., for removing paint from locomotive driving wheels. The apparatus was designed by Mr. A. J. HORTON, Master Car Painter at these shops, and was described by him in the discussion, at the recent meeting of the Master Car Painters' Association, at Boston, on "the best method of removing old, cracked and scaly paint from engine driving wheels and other rough castings."

As seen by the drawings, the apparatus consists of two sheet-iron shells, which, when latched together, form a case enclosing the driving wheel. A rubber hose connects the case with a stationary boiler, and steam is blown into the case. While the case is not steam tight of course it is nearly enough so to keep the wheel in an atmosphere of steam. Old rags or waste are put around the bottom to prevent the escape of steam there. In using the apparatus it is put on the wheel and latched, and steam is allowed to blow in fast enough to balance the condensation and leakage. It requires about 25 minutes to steam a wheel, and the apparatus is then put on another wheel and the first one is scraped and then washed off with strong soft soap, which requires about 30 minutes.

The case weighs about 150 lbs., and as seen by the drawings is simple and inexpensive in its construction. It has been in use at the Elkhart shops since 1887, and has given good satisfaction.

The other methods described consisted in the use of a mixture of concentrated lye and sal soda. One member dissolved these alkalis in water and immersed the castings in it. Mr. QUEST, of the Pittsburg & Lake Erie, uses 30 lbs. lye to 30 lbs. sal soda, mixed with 3 qts. of ammonia, mixed with 21 galls. of water. To use this liquid 30 lbs. of ground unslaked lime are mixed with 5 galls. of water and 3 to 4 lbs. of melted laundry or soft soap. The mixture when cold should be about the consistency of glazier's putty. This was applied to the work to be cleaned in successive coats of about ⅛ in. thickness, either by a small trowel or a 4-in. flat stiff brush. In mixing the lime great care should be used, and a stirring puddle should be left in the mixture to form a vent and prevent the caustic mixture from blowing out.

To remove the paint from one pair of driving wheels by this method costs for material 65 cents, and for labor (15 hours) $2.25. The latter item includes 3 hours labor in heating the wheels by a portable gas stove after it has been rinsed. This is necessary to evaporate the water from the pores of the iron.

Other members practiced burning the paint off, where small castings were to be cleaned; and others advocated scraping as on the whole cheapest.

Fuel Gas and Some of its Applications.*

The advantages of gaseous fuel have been too fully set forth during the past few years to need recapitulation. Systems have found zealous advocates, and promises of results made that have sounded strangely in the ears of old-fashioned gas makers, have been born of theory, and have died in the earliest throes of trial; while in some few instances success has demonstrated the value of practical effort. With few exceptions, however, everything attempted or accomplished has tended toward the one end—the realization of more perfect results than we can obtain with the direct use of solid fuels; and there are to-day few to dispute the coming supremacy and general use of gaseous fuel.

It is not assumed that the solid fuels will be wholly superseded; such an assumption would be folly, as there are circumstances in which solid fuels must continue in use, from necessity or economy. These, however, are few, and can almost be named in a breath; while the purposes for which the gaseous fuel is not only cheapest but best are so many as almost to defy enumeration. Wherever constant high-flame temperature is necessary, the gaseous form must find precedence, while its easy carriage to long distances and its attainment of maximum temperature, almost instantaneously with ignition, give it a leverage that is scarcely covered by that easy term—convenience.

The discovery and application of natural gas has not only borne the weightiest of testimony on behalf of the general necessity for fuel gas in nearly all fields, but it has done more. Its wide scope of service, from the great establishments wherein thousands use it constantly to the cottage where it saves countless steps for the housewife, has demonstrated the necessity for a gas of general application that will fulfill all the demands of the manufacturer and meet the wants of the domestic user. The fuel gas that is to score a wide success must fill these conditions. For a gas that will not, the field is limited.

In the manufacture of a fuel gas, then, it is obvious that certain conditions are primarily necessary.

As concerns the apparatus to be used, these are:

1. *Simplicity.*—It must be easily and cheaply worked, and require a minimum of skilled labor. 2. *Durability.*—It must do its work with but little repair or replacement.

As to the material to be used in the manufacture of the gas, the conditions are:

1. *Richness.*—It must contain the necessary carbon. 2. *Cheapness.*—It must be generally obtainable in large quantities at low prices.

These qualifications are met by slack or fine bituminous coal, which is the least expensive of all coals, and obtainable in nearly all markets at low rates.

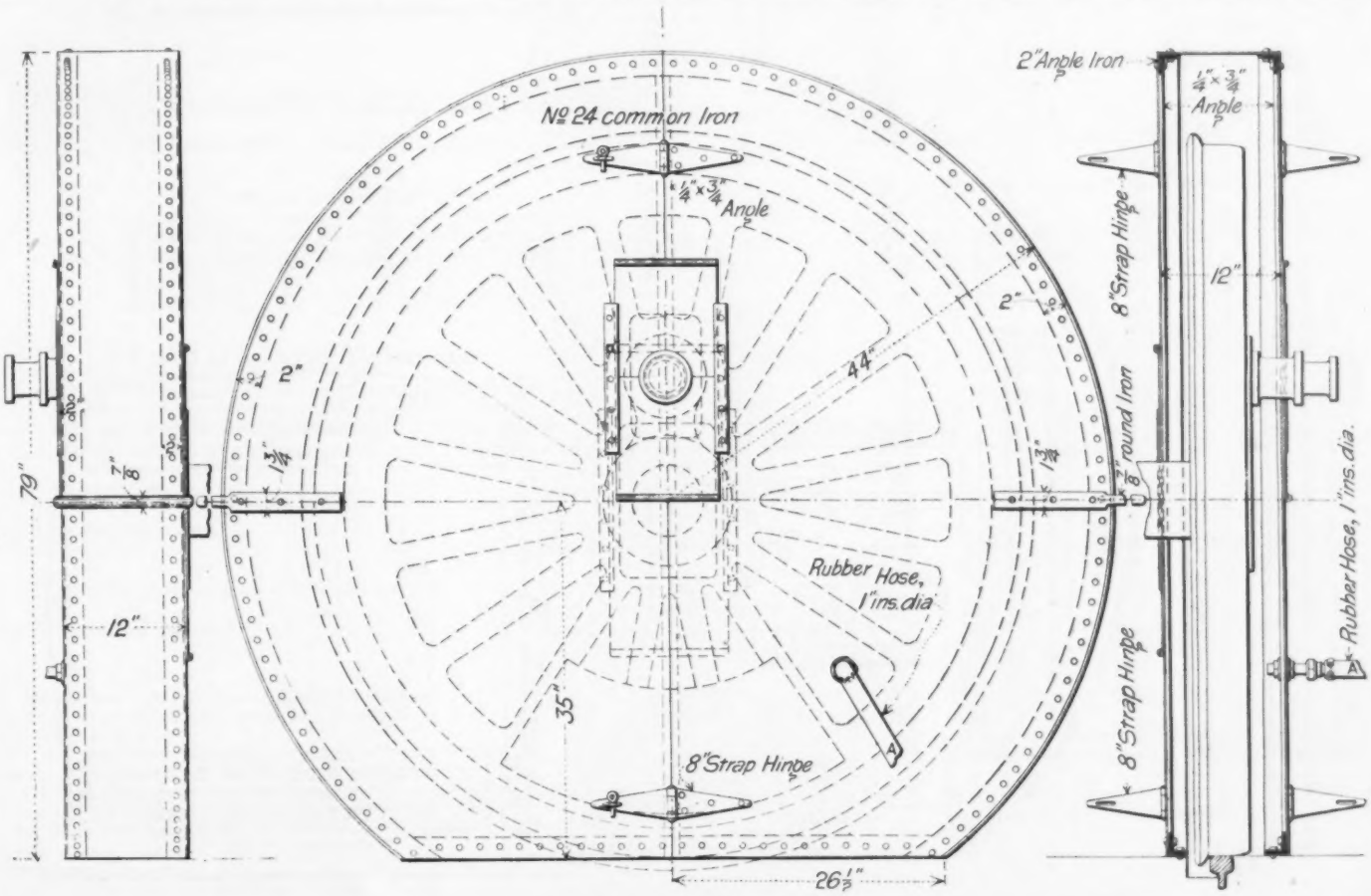
These points established, it remains to decide upon the kind of gas to be made. This must be calculated to meet all the wants of those for whose uses it is intended. Here we find it necessary to consider the following:

1. *Quality.*—The gas must contain all the carbon possible, consistent with the other necessary conditions. 2. *Cost.*—It must be low in cost, especially in view of its use in large quantities. 3. *Cleanliness.*—It must be as free as practicable from impurities, and must be clean as regards the more perceptible. 4. *Transmission.*—It must be capable of easy carriage to reasonably long distances, and through small as well as large pipes. 5. *Temperature.*—It must have a constant high-flame temperature, and must ignite under all conditions when desired.

In many cases, a good producer gas accomplishes all that is needed, and, used in a well-constructed regenerative furnace, is much cheaper than coal; but its usefulness is confined to places where such funaces cannot be constructed, if high flamed temperature is required, or where low heats are sufficient, and obtained without regeneration. Outside of such confines it is not economical, and is seldom useful.

Without discoursing on the relative merits of other gases, I believe that the gas best suited for general fuel purposes is water-gas. Its flame temperature is high, it is cleanly, reasonably free from impurities, and it can be transmitted to long distances.

The one possible factor to which objection might be made is its cost. If it meets this requirement, there is no further bar to acknowledgment of its claims. Can it be made from the cheapest of materials offered in the general market for gas-making purposes? In discussing the lions in the path of success in this direction, the *London*



STEAM-BOX FOR REMOVING PAINT FROM LOCOMOTIVE DRIVING WHEELS; L. S. & M. S. RY.

* A paper presented at the New York Convention of the American Institute of Mining Engineers by Mr. BURDETT LOOMIS.

Journal of Gas Lighting some months ago pronounced the following ultimatum:

The slack, however wet, dirty, dusty, sulphurous or stony, should be tipped into the hoppers of the gas-making cupolas, and gasification should go on continuously and completely, so that nothing but gas and ashes should remain of the material put in the apparatus.

This can be done, and is done, in many places, with the Loomis apparatus, which is using the cheap coals mentioned, as well as the more expensive anthracite coals and coke. This apparatus is the only one that I know of in successful operation making water-gas directly from the bituminous slack coals that are found in abundance in many parts of the world. It is a simple fuel gas-generating machine, and it will not only make as much water-gas from a ton of this slack coal as can be produced by any other method from the same quantity of anthracite or coke, but it also utilizes the blast gases for making the steam necessary to run the engines and exhausters, and for decomposing, leaving a surplus for other work; or the blast producer-gas or generator-gas can be used in regenerative, reheating, annealing, melting furnaces, etc. For these purposes, the producer-gas made by this apparatus answers all requirement, as can be shown by demonstration in the several places where it is so used.

Water-gas generators, to be economical producers of gas, must be so constructed that they will continuously make a first-class quality of gas for the full period of a 24-hours' run. In all the generators using the up-blast system, after a few hours' run the quality of the gas has become much poorer than at the beginning, when the fires were fresh, on account of the clinkers and ashes that accumulate.

In the Loomis generator this is obviated, and the gas is of as good quality at the end of a 24-hours' run as at the beginning or any part of the run. This is due to the peculiar construction of the generator, and the action of the exhauster in collecting the ashes at the bottom of the fire and in the ash-pit. In the process of exhausting before making a run of water-gas, this is highly heated and useful for superheating the steam before it strikes the incandescent coal, and in this way the carbon is nearly all extracted from the coal, less clinker is made, the gas is freer from carbonic acid, and increased production is obtained.

In the matter of quality, a high grade of product should be aimed at, and the water-gas made as pure as possible, so that it can be used, where practicable, without purification. In works where it must be purified, the better the quality of the gas the less the expense for purifying.

The claim has been made that the water-gas that can be made from a given amount of coal must be less economical than the coal used directly, both on account of the smaller number of units of heat contained in the gas and the labor and expense of making. Where coal can be well fired, and gases economically burned direct from the furnace, this is in many instances true, but the great fields for water-gas lie in the special uses for the many kinds of metallurgical work and kindred work where coal directly used cannot enter as a comparative factor, and for domestic purposes, where the gas is proving itself as cheap as the coal, if not cheaper, while it accomplishes results that are not obtainable with the solid fuel.

In estimating the economy of its general uses, another factor must be considered. This is application. In this particular, the threshold of investigation has scarcely been crossed, yet much has been accomplished, while the future is fruitful of certain realization. Until lately, the gas has not been obtainable for the purposes of experimenting in large quantities, and as yet in special work the methods of application are comparatively crude. Within the past few years, however, much has been done in the face of untoward circumstances, and you can now be shown the gas in use in many ways where it has supplanted coal, and wherein it has been found more economical than to fire coal, without taking into consideration any other features of advantage.

In nearly all branches of metallurgical work wherein the gas can be applied, however, there is found an increased product, a better grade of product and direct economy in cost.

Increase in amount of product arises from the saving in direct labor, as can be most easily seen, perhaps, in forge shops and the like, and from the gain in the personal condition of the workmen, owing to the increased healthfulness of their surroundings.

The gain in grade of product arises chiefly from the uniformity in the temperature and the quality of the fuel. The economy in cost needs no explanation. I may state, however, that in some large works which have changed from coal to the use of fuel gas, the gain in direct economy has been proven to be from 33⅓ to 50% in labor and over 40% in fuel.

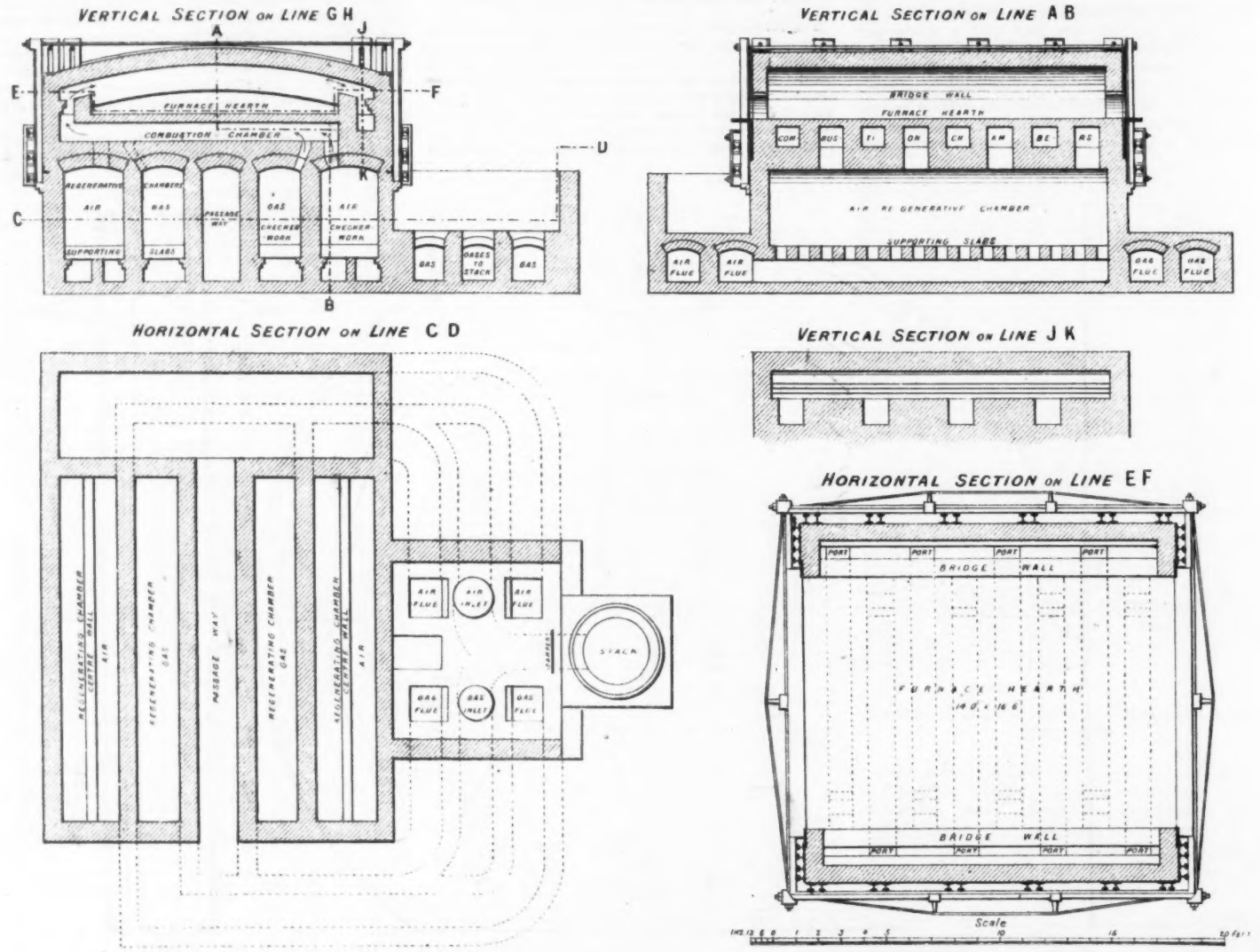
In many instances, the gain from having a sharp, quickly heating flame is such as to overbalance the question of more direct saving in cost of production, and it is not infrequently demonstrated that, by this means, workshop material enough is saved to alone pay all the productive cost of the gas.

Another feature worthy of consideration is economy of space in locating furnaces or other appliances for the use of the gas, especially where it is desirable that these should be grouped together as closely as possible. It also renders possible the location of furnaces, heaters, forges etc., just where desired, without necessity for considering the questions of convenience that frequently arise where there must be either coal carriage or storage.

With this, too, may be considered the fact that the heat from the gas is brought under closer control than that from the coal fire, and there is less heat generated into the room or space surrounding the point of application. This perhaps may seem of minor importance, but in these days of sanitary investigation and of shortening the days of labor, it will be found no little advantage to keep the temperature of the work room as far as possible under control.

In many parts of the world inventors are devising new applications of this gas, and with marked success. It is so well made and so easily handled that its application in many new channels amounts to little more than ordinary manipulation and direction by those who understand the work to be done.

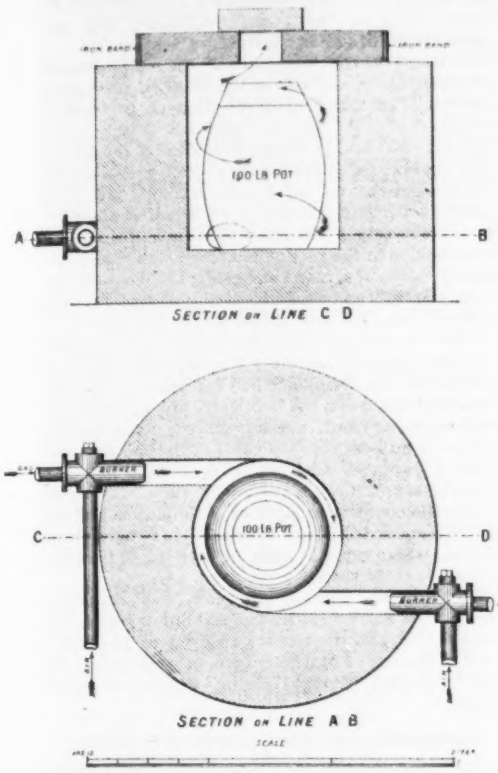
Among the several places in this country where the gas made by the process I have named has been applied to such a variety of uses as plainly shows its adaptability as a general fuel, as regards both efficiency and cost, are the saw-works of Henry Disston & Sons, Tacony, Pa. There you can see the generators at work on steady and continued runs, and will see the two gases, *i.e.*, the water-gas



FURNACE FOR RE-HEATING STEEL PLATES, USING RE-GENERATED PRODUCER GAS.

and the producer-gas, that is made intermittently with the water-gas, both carried to holders, and delivered under pressure at different parts of the works.

This is the first place of which I have knowledge where producer-gas has been stored in a holder, and thence delivered cold to different furnaces at distances from the generators, being fired cold at such distant points.



Spiral Flame Pot Furnace for Water Gas.

Estimated cost of 1,000,000 ft. of water-gas based on actual results, coal at $3 per ton.

Coal, 25 tons, $3 per ton	$75
Coal for steam, 3 tons, $3 per ton	9
Labor	22
Extra for supplies and repairs	4
Purifying	5
	$115
Received for producer gas	40
	$75
Interest on plant and depreciation	25
	$100

Cost per 1,000 ft., $0.10.

In the practical using of water-gas, 20,000 ft. often accomplishes better results than a ton of coal directly fired; in some cases more is used.

This has been accomplished by new and improved methods of application, and will be improved upon as necessity demands and appliances are perfected.

I may say, in conclusion, that in no place where this gas has been put into use has any thought been given to a return to coal. The solid fuel, once supplanted, will never be sought for again.

Figs. 1 to 4 show the way in which producer-gas and water-gas are made alternately.

In bringing the coal to an incandescent state for making water-gas, the door *A* is open, the exhauster *E* is started and draws the air down through the coal and ash-pit and up through the cooling boiler, and the producer-gas made by this operation is forced through a pipe to the holder.

When the coal is in a proper state for decomposition of steam the exhauster is stopped, the door *A* shut, steam is let on by the valve *b* at point *X*, and it passes through the ash-pit and grates, where it is highly superheated, then through the mass of coal, making water-gas, which passes out at *P* through the seal box *N* to the water-gas holder.

After a run of about 5 minutes, the steam is shut off, the door opened, the exhauster started, and the process of making producer-gas is again commenced.

The following actual results have been obtained melting brass in crucibles with water-gas with improved furnace:

In melting 2,000 lbs. of brass in 100-lb. crucibles, 12,000 cu. ft. of water-gas was consumed. In using same size of crucibles in works that are melting from 5 to 10 tons per day with coal, it takes 2,000 lbs. of coal for 2,000 lbs. of brass.

Units of heat in 12,000 ft. water-gas used, 3,600,000; units of heat in 2,000 lbs. coal used, 27,000,000, or seven and one-half times the amount that is in the gas used. One ton of coal will make 40,000 cu. ft. of water-gas, which will accomplish as much as 3⅓ tons of coal in this work.

The cost of labor in making water-gas will be less than in firing coal direct. The producer-gas made, in addition to 40,000 ft. of water-gas from a ton of coal, will yield all the steam needed and pay interest and repairs on the plant.

The coal used for making the gas, being bituminous slack, only costs two-thirds as much per ton as that used with direct firing.

One ton of coal to make the gas, costing $3; 3⅓ tons at $4.50 per ton will cost $13.50, saving on coal in melting 3⅓ tons, $10.50.

As it only requires two-thirds the time to melt with gas that it does with coal, here is a great saving, and less space is needed for furnaces, as only one-third the number are needed. Metal is not wasted in the ash, and crucibles will last much longer.

In estimating comparative cost of labor and fuel in making water-gas from bituminous or anthracite coal, there is in the Eastern States and England a difference of about $1.50 per ton between the cost of bituminous slack, and coke or anthracite, and the estimate will be made on that basis. Where it is more or less allowance can be made.

Two thousand pounds Cumberland slack will make 40,000 cu. ft. of water-gas with 340 h. u. per foot, or 13,600,000 per ton. Cost of coal, $3; cost of labor per ton, $1; producer-gas makes steam; total, $4.

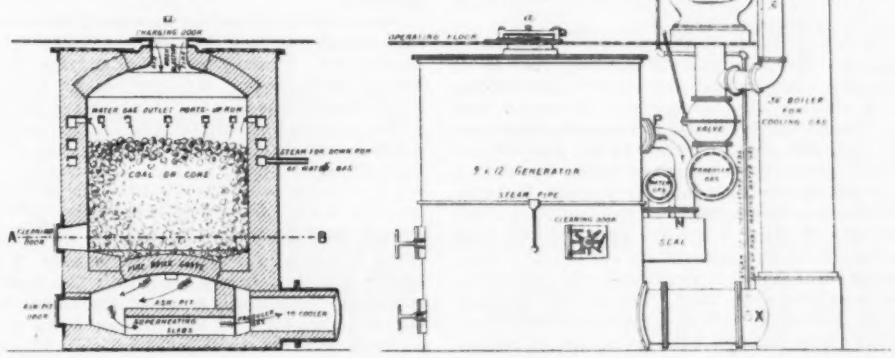
Making 1,000,000 h. u. costs about 30 cts. If the balance of producer-gas could be utilized after making steam it will reduce the cost of the water-gas as low as 25 cts.

Using 2,000 lbs. anthracite coal or coke, the cost per ton coal is $4.50; cost of labor per ton coal, $1; coal for steam, 75 cts.; total, $6.25.

If it makes 40,000 cu. ft. at 300 h. u. per ft. or 12,000,000 per ton, 1,000,000 h. u. would cost 52 cts., or nearly double that made from bituminous slack. The extra units of heat in gas made from bituminous coal is obtained from th Marsh gas illuminants, which gives the gas a decided odor.

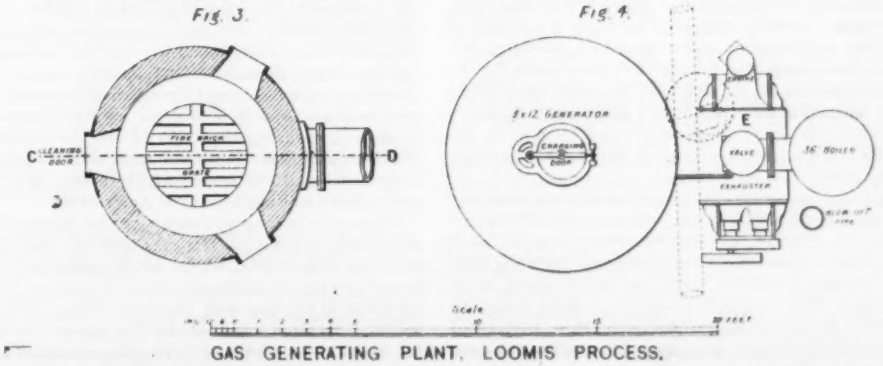
VERTICAL SECTION on LINE C D
Fig 1.

ELEVATION
Fig 2



HORIZONTAL SECTION on LINE A B
Fig. 3.

PLAN
Fig. 4.



GAS GENERATING PLANT. LOOMIS PROCESS.

Red Rock Cantilever Bridge—Correction.

On authority of Mr. SAMUEL M. ROWE, Chief-Engineer A. & P. R. R., we named Mr. J. A. L. WADDELL as the "designing engineer" of the Red Rock Cantilever which was fully illustrated in our issue of Oct. 4 and preceding ones. We now learn, however, that while Mr. WADDELL, as Western representative of the Phœnix Bridge Co., and a member of its engineering staff, rendered material assistance in the preparation of the designs and estimates, they were entirely worked up by the engineering office of the Phœnix Bridge Co., so that the naming of any one person as the designer was not warranted.

The International Engineering Convention.

We continue from last week our report of the proceedings of the British Iron and Steel Institute and *Verein Deutscher Eisenhuttenleute* in their joint meeting with the American Institute of Mining Engineers.

At the last session of the Iron and Steel Institute in New York, on Friday morning, Oct. 3, the first paper presented was by R. A. HADFIELD, of Sheffield, England, on "Aluminum Steel," of which we publish a full abstract. Mr. HADFIELD is a famous steel producer from a city famous for the quality of its steel, and has made exhaustive experiments as to the effect of dosing steel and iron with aluminum. Incidentally the paper contained considerable matter in reference to the production of aluminum; and the author gave cordial praise to the work done by American metallurgists in the development of the remarkable new processes, which have so quickly displaced the old and expensive ones, and have made practical the extensive use of aluminum in the arts: After a discussion by Messrs. STEAD, MARTIN and others, Sir JAMES KITSON proposed the usual formula: "that the very best thanks of the Institute be presented to Mr. HADFIELD for his able and interesting paper," and added that Mr. HADFIELD had just been chosen a member of the Council of the Institute.

We described last week the surprising manner in which American practice in blast furnace work and in steel making had forged ahead of British practice, as shown by the papers of Messrs. HOWE and GAYLEY. But the next paper read before the Institute described an art which is entirely American, in both origin and development—the art of electric welding. Every one of the visitors from abroad had heard of electric welding, and they were about

equally curious to see a weld made by electricity and to see and hear the inventor of this and other wonderful electrical devices. It is entirely safe to say that no one was disappointed in either the process or the inventor. Prof. THOMSON is not only an inventor but a public speaker of uncommon talent, and his plain, matter-of-fact description of the process and its development was listened to with absorbing interest. In this connection a curious fact may be noticed. Prof. THOMSON and in fact nearly every one of the Americans who have been prominent in the discussions before the Institute are young men.

Prof. THOMSON's coal black hair shows not a thread of gray, while Prof. HOWE, and Messrs. POTTER, GAYLEY, COOK, HUNT and other Americans who took a prominent part in the discussions cannot claim reverence on account of their age. On the other hand the "heavy weights" among the British and German guests are men ripe in experience and far advanced in years.

In concluding his address, Prof. THOMSON announced that on the return of the excursionists to New York, the Thomson-Houston company will organize an excursion to visit their works at Lynn, Mass., furnishing free transportation to those who desire to take the trip.

In thanking Prof. THOMSON for his paper, Sir JAMES KITSON said that it was impossible to predict what great revolutions in mechanical construction might not grow out of this marvelous invention. The ability to unite pieces of metal, without the dirt and smoke of the forge, with a joint almost as strong as the solid metal, and by a machine convenient and simple to operate, might wholly revolutionize many mechanical industries.

Dr. C. B. DUDLEY, of Altoona, then presented his paper on "The Wear of Metal as Influenced by its Chemical and Physical Properties." Experiments were made by the Pennsylvania Railroad's test department some years ago to determine the causes affecting rail wear. Contrary to the generally received opinion, these tests showed that the rails of high carbon or manganese wore fastest. While no definite tests have been made since that time, about 2,500 tons of rails were made by a formula then recommended, having a carbon about 0.30%, manganese about the same, and phosphorus about 0.01%, and were laid on the New York & New England R. R. No definite data as to the actual traffic over these rails are available, but it is quite heavy. Neither have any careful determinations of the loss of weight by wear been made, but the roadmaster says that the rails do not appear to have worn at all in the seven years they have been in service.

Dr. DUDLEY alluded to a paper before the International Railway Congress in Paris a year ago in which experiments were described, showing diametrically opposite results to those made by the Pennsylvania R. R., viz., that the rails with highest carbon showed the best wear. Dr. DUDLEY thought this anomalous result must be due to the softer rails having been rolled very rapidly, and being therefore of poor quality.

Describing experiments on locomotive tires containing 0.60% to 0.70%, and even as high as 1% of carbon, Dr. DUDLEY said that here, too, in every case, the tires with least carbon wore best. The tires with high carbon, which were hardest to turn, wore fastest. The tires which wore best were found to have a high percentage of silicon, thus indicating that silicon is not so detrimental to steel as has been supposed. Similarly, experiments on bearing metal showed that the softest metal, that with the least tin and most lead, wore slowest.

In conclusion, enumerating the characteristics of a metal which influence its wear, Dr. DUDLEY placed resilience, as shown by elongation under a tensile test, at the head. This being secured, greater ultimate tensile strength is an advantage. Lastly, and possibly more important than either of the preceding, the granular structure of the metal influences wear. The finest grained metal wears slowest.

Sir LOWTHIAN BELL, who is a member of the locomotive committee of the Northeastern Ry., said that he fully agreed with the author as to the difficulty of testing the resistance of rails to wear. He was anxious to find some rapid method of testing rail wear, and a machine had been devised for that purpose which works by grinding the rail, but it had not yet proved successful. The question of rail composition had frequently been discussed by the Northeastern Railway's locomotive committee, and 0.3 or 0.4 to 0.5 per cent. had been settled on as the best proportion of carbon. They had not found that the softer rails wore better. He was surprised to learn the high percentage of carbon in American locomotive tires. In England about 0.45% carbon was the rule, and he would be alarmed to know that tires were running with so high a percentage of carbon as 0.6% or 0.7%.

The session then closed with a hearty vote of thanks to the American Institute of Mining Engineers, the American Iron and Steel Association, the local committees who had extended and were to extend hospitalities to the visitors, the general reception committee, the ladies of New York and other cities who entertain the lady members of the party, and the American railway and transportation companies who extend courtesies on the various excursions.

Sir JOHN ALLEYNE then called for a vote of thanks to the President, Sir JAMES KITSON, saying that the best meetings the society had ever held were those which had been held during his term of office, and of these the most brilliant are those which have just been held in America.

This concluded the formal sessions of the Institute and everybody made haste to catch the boats and trains for the afternoon excursions. The best patronized was the excursion to Edison's laboratory at Llewellyn Park, N. J.. for the visitors were all anxious to see the famous American inventor. A good number, however, went to the Tilly Foster iron mine to see the great lock excavation and the magnetic process of ore concentration described last week.

About 150 others took the steamer *Laura Starin* for a trip up the East and Harlem Rivers to the Navy Yard, Washington Bridge and the De La Vergne Refrigerating Machine works. Unfortunately the tide was too low to run up the Harlem, so the excursionists had to give up the last two sights and content themselves with a visit to the Navy Yard.

PHILADELPHIA.

If any Londoner among the visitors had experienced a feeling of homesickness because of the bright skies and balmy air which the weather bureau had thoughtfully provided for the first four days of the meeting, he was entirely cured by the fog and heavy rain which prevailed on Friday, and which gave the Britishers a valid excuse for turning up the bottoms of their trousers as they trudged about New York's muddy streets. But after one day of this cheerfulness, for the especial benefit of the Londoners the wind blew from a different quarter, and a more perfect morning for the start on the long excursion than Saturday proved to be could not have been imagined. The especial train of two 8-car sections left Jersey City over the Pennsylvania Railroad at exactly 9:15 A. M., as Mr. SHINN had promised, carrying about 700 of the excursionists. The Iron and Steel Institute members were in the majority, but the Germans filled several cars, and there was a fair sprinkling of Americans.

The train drew up at Tacony, on the banks of the Delaware, in front of Henry Disston's Sons' Saw, Tool and File Works, where the excursionists were greeted by the Philadelphia local committee and by members of the firm and foremen of the Disston's works. An hour was spent by the visitors in looking about the works, a time too short to catch more than a brief glimpse of the various interesting processes. Among the novel sights to the foreigners were the straightening machines for hand saws—little hammers, driven by a crank, which strike blows faster than one can count, and greatly shorten the final hand straightening process. The removable teeth for circular saws were also an unheard of novelty; but what made the eyes of the visitors bulge with amazement was to see the little machine which cuts the teeth on a hand saw in three seconds. This is one of the very few cases where metals are cut with something of the rapidity which characterizes wood-working machines. The blank of sheet steel which is to form the saw is gripped between rolls and moved steadily along in front of the cutters. These are mounted on a wheel revolving very swiftly in a plane perpendicular to the line of motion of the blank; and as each cutter strikes the edge of the blank it cuts out a triangular piece, and so forms the teeth.

Long before the visitors had finished their tour of the works the steamer *Columbia*, which was lying at the wharf, gayly decorated with the English, German and American flags, and with other gay drapery until she looked, as an enthusiastic Englishman said like a fairy boat (he pronounced it *ferry* boat, but he didn't mean it)—the steamer *Columbia* was impatiently blowing her whistle for the start.

On board the boat were several hundred prominent Philadelphians, and also on board was a prodigious amount of solid and liquid refreshment. The formal reception of the guests was brief and highly satisfactory. Mr. JOS. D. POTTS, President of the Reception Committee, welcomed the visitors with a cordial little address, and Sir JAMES KITSON and Herr ALEXANDER THIELEN replied on behalf of their respective societies. The latter speaker had some loud competition in the roar of escaping steam from the safety valves of a vessel alongside; but he held the floor manfully and closed by giving with his German comrades three hearty cheers for Philadelphia.

With the close of these formalities the informal exercise began of devouring the abundant luncheon which the Philadelphians had furnished, while the boat steamed down the Delaware, along the Philadelphia water front, passing among other notable points of interest the ship yards of the CRAMPS, the ROACH yards at Chester, Fort Mifflin, and the League Island Navy Yard. The turn was made when the boat was in sight of Wilmington, and the party was landed at the Chestnut St. wharf about 5 P. M., where vehicles were in waiting to take the guests to their hotels.

By a wise and humane provision of the reception committee, Saturday evening and Sunday were left unassigned, and the visitors enjoyed a quiet day's rest in the city of brotherly love, in preparation for the busy week of sight seeing which was before them.

JOHNSTOWN AND THE CAMBRIA IRON WORKS.

The commodious dining room of the Logan House gave lunch to each of the three divisions of the party in succession, and this important business finished, the start was made across the Allegheny Mountains. A heavy consolidation engine was put ahead of the two regular engines to haul the train of Pullman cars up the grade. The day was as bright and pleasant a one as could be desired, and the foliage on the mountain slopes was at the height of its autumnal glory. As the train slowly climbed the steep grade around the Horseshoe curve, the delighted excursionists grew enthusiastic over the magnificent vista and the achievement of engineering skill which enabled them to view it.

As soon as the Conemaugh Valley was reached the interest of the foreigners was redoubled, and for 10 miles they watched the evidences still left of the great flood of June, 1889. At Johnstown the party were met by the local reception committee, headed by Mr. JAS. H. GEER. Two trains of flat cars awaited the visitors on the Cambria Iron Co.'s railroad, and the party was treated to a ride up through the flooded district for a mile or more, and then down through the works of the Cambria Iron Co. Over an hour was spent here in looking through the works, which were the best and most extensive that the visitors had yet seen in America. One of the most interesting things to the metallurgists was the Krupp-Bell dephosphorizing furnace, which makes a fine grade of high carbon steel from pig iron containing a considerable percentage of phosphorus. The only plant in use besides the one here is at Youngstown, O. The total number of employés of the Cambria Iron Co. is above 8,000.

While the inspection of these works was in progress the ladies of the party were entertained by ladies of the Johnstown reception committee, and were taken for a carriage drive through the flooded district and the chief points of interest in the city. After about three hours among the interesting sights of Johnstown the excursionists returned to their trains, and a swift run to Pittsburg was made. Delegates from the Pittsburg reception committee had already met the visitors at Altoona and assigned the party to various hotels; and those for whom hotel accommodations could not be provided were taken as guests in private families of Pittsburg and Allegheny. As the train approached its destination much merriment was excited among the foreigners by an article in a Pittsburg local paper beginning "The Mechanical Brain of Europe Ap

proaches Pittsburg!" It was certain, however, that both the mechanical brains and intellectual bodies of the excursionists were very weary after the busy day, and the opportunity for a quiet night's rest in Pittsburg was much appreciated.

THE PITTSBURG INTERNATIONAL SESSION.

At 10 A. M., Thursday morning an audience assembled in Carnegie Hall, Allegheny, which nearly filled that spacious and splendid audience-room. Sir JAMES KITSON occupied the chair, and the exercises opened with an address of welcome by Mr. JOHN H. RICKETSON, Chairman of the Pittsburg Reception Committee. Sir JAMES KITSON then made a formal address, and read a paper prepared by Sir HENRY BESSEMER, describing the manner in which he came to invent the Bessemer process, and the progress of that art in its early days.

After announcements concerning the different excursions a paper on "The Probable Future of the Manufacture of Iron" was read by Sir LOWTHIAN BELL. He considered it impossible that any form of "direct process" for producing iron from the ore could ever drive out the blast furnace and the Bessemer and open-hearth steel processes. Nor did he believe the direct process could ever amount to much in practice. In discussing this paper Prof. MAYNARD described the direct process in use by the Carbon Iron Co., of Pittsburg, whose works have now capacity for an output of 134,400 lbs. per day. The loss of metallic iron, which has been the weak point in other direct processes, is here reduced to 6¾%. The fuel required is somewhat less than that used in puddling wrought-iron. Mr. HENRY M. HOWE agreed with Sir LOWTHIAN that the blast furnace was more likely to dispense with the direct process than the latter was likely to dispense with the blast furnace. However, he believed the direct process had possibilities of great development, especially in view of the fact that it requires a much lower temperature than the blast furnace. The direct process is only suited to rich ores and for localities where proper fuel can be obtained. Much of the Carbon Iron Co.'s success may be due to their use of natural gas. Mr. SNELUS pointed out the applicability of the direct process to ores treated by the magnetic concentrator, inasmuch as the direct process requires the ore to be pulverized.

Sir LOWTHIAN BELL replied to these criticisms, saying that the very fact that the direct process required the pulverizing of the ore rendered it unsuitable for general use. He saw no chance that the direct process would economize fuel, and considered the scheme "one of the most utopian ideas that ever entered into the mind of man."

The paper on "The Protection of Iron and Steel Ships against Foundering from Injury to their Shells: Including the Use of Armor," by Sir NATHANIEL BARNABY, K. C. B., was read by title only, its distinguished author not being present, and brief remarks upon the paper were made by Commander BARBER, U. S. Navy. The paper by A. E. SEATON, on "The Development of the Marine Engine and the Progress Made in Marine Engineering during the Past Fifteen Years," was formally presented by title, and adjournment was taken.

In the afternoon the visitors separated in light different parties, going in various directions on excursions arranged by their Pittsburg hosts.

NEW PUBLICATIONS.

OCTOBER MAGAZINES.

Of all the scientific articles in the October magazines undoubtedly the most striking and significant is that "On Meteorites and the History of the Solar System," by G. H. DARWIN, in the *Century*. It contains a very recent photograph of a nebula in Andromedee, which appears to show a vast solar system in actual process of formation as the theories of LAPLACE and KANT required, formed when astronomy was young, and it was not dreamed of that such confirmatory evidence could ever be obtained. The article will not bear abstracting, but is of extreme interest.

The *Century* and *Popular Science Monthly* both contain another article on that somewhat threadbare subject, the cave dwellings of the West. Both articles, however, appear to be among the best and fullest of such articles, describing some specially interesting cave dwellings and fortifications which have never been described before. Both articles are exceptionally well illustrated.

Scribner's contains a number of scientific articles, the best, perhaps, an excellent architectural article on the "City House in the West," by JOHN W. ROOT. A brief article on "Sand Waves at Henlopen and Hatteras" describes some aggravated and little known instances of a phenomenon which is common to many points of our sea and even lake coast. At Hatteras, however, there is the peculiar fact that the whole formation of these movable sand hills is very recent (within 50 years) and directly traceable to denudation of the live oak and other dense forest growths along the shore. Mr. N. S. SHALER continues his study of "Nature and Man in America," but hardly with sustained interest, which indeed was hardly to be expected, the first article being of quite exceptional interest. He predicts with much plausibility the probable future of the several districts of the continent from their physical characteristics, stopping just short of the greatest problem of all, the future of the arid plains of the West, which will be considered next month. The articles, "With a Cable Expedition" and "With the White Squadron," are also excellent on their respective topics. Few not directly concerned realize what a vast department of modern industrial activity cable telegraphy has already become.

Harper's contains an article by Prof. J. S. NEWBERRY on "The First Oil Well," giving somewhat surprising evidence that various surface oil wells 25 ft. or so in depth "were *abandoned* at least 400 or 500 years ago" It also gives a resumé of the early history of the modern oil era. Few know that in Burkesville, Ky., so early as 1829, a genuine spouting oil well was struck in boring for salt, which covered the Cumberland River with oil for 40 miles, the oil taking fire, and, of course, greatly terrifying the district. Mr. CHILD'S excellent articles on Chili are continued.

The *Forum* contains an article by the now famous EDWARD BELLAMY on "First Steps toward Nationalism," *i. e.*, State ownership of the railways, telegraphs, mines, etc., which Mr. BELLAMY considers, not without certain signs and strong arguments in his favor, to be near at hand and easily practicable. Much better worth reading for immediate interest, however, is Mr. MAGEE'S article on "China's Menace to the World," somewhat exaggerating, we think, the indubitably great industrial capabilities of the Chinese, but putting them very vividly. Mr. REDWAY'S article on "Climate and the Gulf Stream" is also well worth reading, seeming to show that the "sphere of influence" of this stream is much exaggerated, and its real nature not yet determined.

The *North American Review* contains nothing of technical interest except an article by Mr. MICHAEL DAVITT on "Labor Tendencies in Great Britain," and by ANDREW D. WHITE on "The Future of the American Universities," which are well worth reading by those interested in the subjects to which they relate. The *Popular Science Monthly* contains another article on those curious formations, "The Barrier Beaches of the Atlantic Coast," and an interesting industrial article on "Cotton Spinning North and South." The article on "Irrigation in China," by a prominent Chinese general, who speaks from inside knowledge, is, perhaps, the most permanently valuable article of this issue on any subject, and should be read by those interested either in China or irrigation.

—*Town of Andover. First Annual Report of the Water Commissioners for the Year Ending Feb.* 3, 1890. Paper, 8vo., pp. 35.

This report contains a general review of the history of the works to the date named, together with a progress report by the Engineer, PERCY M. BLAKE, and his Assistant, ERASTUS WORTHINGTON, JR.

—*Reports of* T. H. MCCOUN, *City Surveyor, and* A. FTELEY, *Consulting Engineer, on a General Sewerage Plan for Hoboken, N. J.* September, 1890. Pamph., 8vo. pp., 12.

The report advises a gravity system to convey sewerage to pumps, and pumping for the final disposal of the sewage into the Hudson River.

—*Fireman's Manual.* A memento of the Eighteenth Annual Convention of the Firemen's Association, State of New York. Watertown, N. Y., 1890. Agricultural Insurance Co. Paper. pp. 112.

This volume is made up of somewhat extended information regarding fire departments, and in addition contains an article entitled "Water-Works and Sewerage for Small Towns and Villages," by STEPHEN E. BABCOCK, C. E., of Little Falls, N. Y.

PERSONALS.

Mr. P. RYAN has been appointed roadmaster of the Louisiana Western Division of the Southern Pacific R. R.

Mr. JOHN STERLING DEANS, Engineer of Erection for the Phœnix Bridge Co., was married Oct. 1 to Miss CLARA VIOLET BARR at the Church of Our Savior, Cincinnati, O.

Mr. A. H. SMITH, for some time connected with the Bridge Department of the Lake Shore R. R., has been appointed Superintendent of the Kalamazoo Division of that road.

Mr. H. R. NICKERSON has been appointed General Superintendent of the Gulf, Colorado & Santa Fe Ry. Mr. JAMES COLLISON has been appointed Master Mechanic of the Chicago extension of the same line.

Mr. CHAS. H. CROMWELL, for some time Traffic Manager of the Western Alabama and Atlanta & West Point lines, has tendered his resignation to accept the position of General Manager of the Atlantic & Danville Ry.

Mr. L. J. BARBOT, City Engineer of Charleston, S. C., and Mrs. BARBOT have been spending a few weeks in New York and vicinity. Mr. BARBOT has been a subscriber to ENGINEERING NEWS from the first number, published in 1874.

Gen. CHAS. B. PECK has resigned his position as Vice-President and General Manager of the Atlantic & Danville Ry. The office of General Manager has been merged into that of Vice-President, now held by Mr. R. M. STUART-WORTLEY.

Mr. J. C. NAGLE has been appointed Assistant Professor of Engineering at the Agricultural and Mechanical College of Texas. Mr. NAGLE is a graduate of the University of Texas and was topographer for some time on the U. S. Geological Survey.

Mr. J. M. GRAHAM has been appointed Assistant Superintendent of the Northern Pacific R. R. in charge of the lines east of Billings, Mont. Mr. F. E. MICHAELS has been appointed Superintendent of the Manitoba Division with headquarters an Winnipeg, Man.

MR. HENRY C. ALLEN, late Deputy City Engineer, has been appointed City Engineer of Syracuse, N. Y., vice H. WADSWORTH CLARKE, resigned on account of ill health. MR. ALLEN is but 26 years old, and the youngest man who has ever held the office. He began his engineering experience under Major CLARKE, whom he now succeeds.

Messrs. JOHN R. KALEY and P. H. BAERMANN, Civil Engineers, have opened an office at No. 10 First St., Troy, N. Y., for the designing, construction and superintendence of all work pertaining to water-works, sewerage, municipal engineering, water power, etc. An extensive practice and experience of 20 years is their capital an guarantee.

Mr. J. W. BUSHNELL has resigned his position as Chief Engineer of the Florida Central & Peninsula R. R. When he commenced work in Florida 12 years ago, the only railway in the State was the old Transit route from Fernandina to Cedar Key and Lake City. He directed the construction of the F. C. & P. R. R. from Orange Lake through to Tampa, a distance of over 200 miles.

MAJOR H. W. CLARKE, M. Am. Soc. C. E., has resigned the position of City Engineer of Syracuse. He had been confined to his home for several weeks with severe illness, the effects of overwork since assuming the duties of the office. Finding that a long season of absolute rest and freedom from the cares of business will be required to regain his health, he tendered his resignation. Mayor COWIE, in a very cordial note, has conditionally accepted it, proposing to place him again at the head of the department so soon as his health may be assured. Meanwhile Major CLARKE'S deputy has been appointed to succeed him.

MR. JAMES F. GODDARD, the new Commissioner of the Trunk Line Association, and the successor of Mr. ALBERT FINK, was born in Brockton, Mass., on Jan. 28, 1842. When 26 years old he entered the railway service as a clerk in the general freight office of the Chicago, Burlington & Quincy, and from January, 1872, to November, 1874, he was assistant general freight agent of that road. Then he became general freight agent of the Hannibal & St. Joseph, but in September, 1875, he returned to his old post on the Quincy road. He quit it again in July, 1878, to become general freight agent of the Atchison, Topeka & Santa Fé. While in the service of this road he held necessarily the offices of traffic manager, assistant general manager, general manager, and Third Vice-President. The latter post he resigned to become Commissioner of the Western Passenger Association. This office he resigned about a month ago. He recently declined the offer of the Commissionership of the Gould-Huntington-Atchison-Southwestern combination, which is now in process of organization. Mr. Goddard will have charge of both the freight and passenger departments of the Trunk Line Association.

SOCIETY PROCEEDINGS.

Railway Superintendents.—At a meeting held in New York, Oct. 7, the business embraced reports of standing committees, an address on "Recent Improvements in the Air Brake" by Mr. H. H. WESTINGHOUSE, the reading of a paper on "Systematic Handling and Distribution of Cars" by W. G. WATTSON, the reading of a paper on "Rail Fastenings and Rails" by JAMES CHURCHYARD, and some remarks by the Secretary on "Semaphore Signals and Interlocking." The practical workings of the standard code of the General Time Convention was also discussed. The Chairmen of the standing committees are: J. B. MORFORD on Roadway, G. W. BEACH on Machinery, and ROBERT BLEE on Transportation.

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COMING TECHNICAL MEETINGS.

American Society of Swedish Engineers.—Semi-annual meeting, Oct. 11. Secy., M. Dahlander, 320 Sackett St., Brooklyn, N. Y.

Denver Society of Civil Engineers.—Convention at Manitou, Oct. 11. Secy., Geo. H. Angell, 36 Jacobson Bldg.

Civil Engineers' Club of Cleveland.—Next meeting, Oct. 14. Secy., C. O. Palmer, 22 Cedar Ave.

Engineers' Club of St. Louis.—Next meeting, Oct. 15. Secy., W. H. Bryan, 30 South 7th St.

American Society of Civil Engineers.—Next meeting Oct. 15. Secy., John Bogart, 127 E. 23d St., New York.

Boston Society of Civil Engineers.—Next meeting, Oct. 15. Secy., S. E. Tinkham.

New York Railway Club.—Next meeting, Oct. 16. Rooms, 113 Liberty St.

Engineers' Club of Cincinnati.—Next meeting, Oct. 16. Secy., J. F. Wilson.

Engineers' Club of Philadelphia.—Next meeting, Oct. 18. Secy., Howard Murphy, 1122 Girard St.

Western Railway Club.—Next meeting, Oct. 21. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery, Bldg.

Engineers' Society of Western Pennsylvania.—Next meeting, Oct. 21. Secy., S. M. Wickersham, Pittsburg, Pa.

Civil Engineers' Society of St. Paul.—Next meeting, Nov. 3. Secy., G. L. Wilson.

Western Society of Engineers.—Next meeting, Nov. . Secy., J. W. Weston, 230 La Salle St., Chicago.

Civil Engineers' Association of Kansas.—Next meeting, Nov. 5. Secy., J. C. Herring, Wichita, Kan.

Association of Civil Engineers of Dallas.—Next meeting, Nov. 7. Secy., E. K. Smoot, Elm and Austin Sts.

Technical Society of the Pacific Coast.—Next meeting Nov. 7. Secy., O. von Geldern, 408 California St., San Francisco.

Engineering Association of the Southwest.—Next meeting, Nov. 13. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

THE last New York Central report, issued late this week, shows the following highly creditable, in fact astounding, increase in average train load during the past year, due in part, beyond doubt, to the recent introduction of heavier engines :

	1889.	1890.
Average freight train load, tons	237	263
Average freight haul, miles	181	178
Average receipts per ton mile, cts	0.75	0.75
Average expenses per ton mile, cts	0.56	0.53
Average profit per ton mile, cts	0.19	0.22

The comparative engine miles and ton miles stand as below, showing that in the last year a notably smaller number of train miles has handled many more ton miles, and showing also that the notable decrease in expense per ton mile has been accomplished in the face of a considerable increase in switching mileage, which is almost as great as that made by engines hauling trains :

	1889.	1890.
Freight train mileage	12,455,897	11,997,764
Switch and work train mileage	10,269,880	11,310,122
Ton mileage	2,952,696,190	3,158,756,569

Lest it may be thought that this notable progress is in part due to a bad record last year we give the average New York Central train load in tons since 1873, as follows :

	1873.	1878.	1883.	1885.	1889.	1890.
Tons	129	186	200	204	247	263
Inc. p. c.	...	44.2	55.0	58.1	83.7	103.8
Rate, cts.	1.57	2.93	0.91	0.68	0.75	0.75

When we consider that these average train-loads are obtained in spite of a disproportion of traffic amounting to about 3 east to 1 west, and that only about one-eighth of the tonnage transported is through freight, the rest being local from various points, it is hard to imagine a more creditable record. One important fact which has contributed to this end, undoubtedly, is the vast increase of traffic, which in 17 years has steadily increased from 769 to 3,158 million ton miles, or 4.1-fold. But to show that there is nothing exceptional in this record, we give the corresponding record of increase of train-load on the Pennsylvania Railroad for the same period:

Year	1873	1878	1883	1885	1888	1889
Tons	111	154	189	209	213	219
Increase, p. c.		38.7	60.3	88.2	91.8	106.2

So we might go on with almost every railway in the United States, nearly all of them showing a substantially similar steady increase in train-load hauled.

THE report of Chief Engineer FTELEY, elsewhere very fully abstracted, presents in very plain and sensible terms the facts of the case concerning the much discussed Quaker Bridge Dam problem. While showing the necessity for a high dam in fully utilizing as a source of water supply the whole flow of the Croton water shed and admitting the consistency of the original plan contemplating the simultaneous building of the aqueduct and dam, Mr. FTELEY very clearly points out that, under the changed conditions resulting from delay in commencing the dam, it can now be postponed for 20 years, if not altogether omitted.

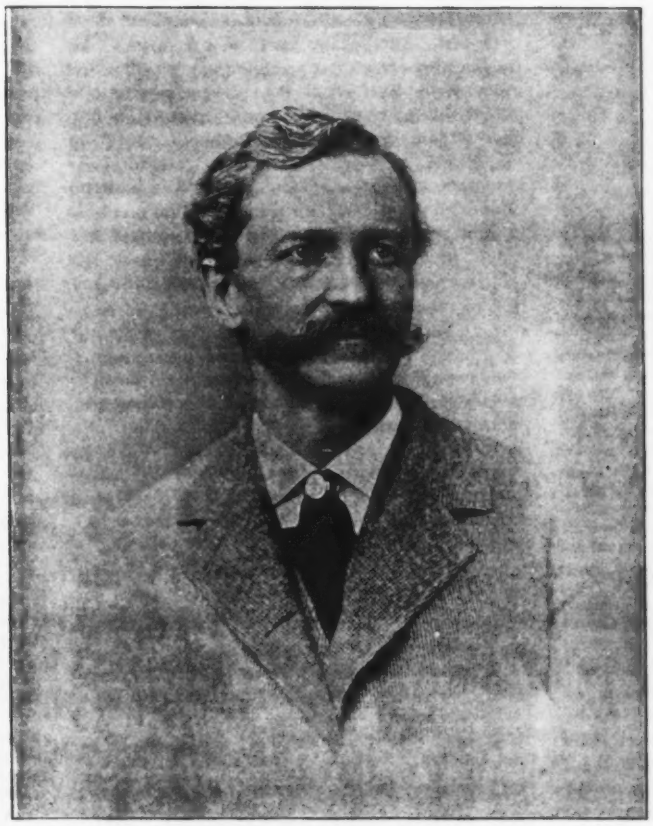
Assuming that the new Croton dam is built, in about half the time and at less than half the cost of the higher dam, and that the reservoirs on the upper water shed are completed as now contemplated, it seems to us that about all is done in the way of utilizing the Croton water supply that wisdom would recommend. If, after 20 years, the consumption of water by New York has grown to such an extent as to overtax the storage now provided by Mr. FTELEY, the limit will be so nearly reached that it will be sound policy to look abroad for any additions to the Croton supply. Mr. FTELEY recognizes the value of the lower watershed, provides a reasonable and economical method of storing water on the lower main river, and backs his conclusions and recommendation by forcible arguments. Two hundred days' storage, with a consumption of 250,000,000 galls. per day, should bridge over any dry season possible in this latitude for many years to come. And when these figures fall short, as they may in the future, the Croton water shed will be practically out of the question and exhausted. In plain terms, it looks very much as if we never did or would actually need the enormous Quaker Bridge Dam, after all the heated argument and printer's ink that had been expended upon it. Had it been built along with the Aqueduct it would have at least postponed the construction of some of the upper dams, and would doubtless have served an excellent purpose, leaving out of consideration cost and risk. But after modifying the present report the natural conclusion is that it might have been wiser to have adopted this last plan in the first place.

As we have had occasion to note lately, the tendency of the present large immigration to this country is rather unfortunate, in that it shows a decided increase in Italian, Hungarian and Polish emigrants, which is not only a more ignorant and degraded element on an average than the rest of our immigration, but is also an element foreign to our blood. But in the other hand this element constitutes, and must continue to constitute a much smaller drop in our large and growing bucket than is generally realized, as in fact does foreign immigration generally. We have had the curiosity to abstract the facts of our actual population from the last available census, that of 1880, and it stands as follows:

	Population.	P.c.
Total population	50,155,783	100.00
Of which, native born	43,475,840	86.68
" " English, Scotch, Welsh and Canadian	1,633,271	3.26
Total, native and English	45,109,111	89.94
Irish	1,854,571	3.70
Total, native and British	46,963,682	93.64
German	1,966,742	3.92
Swedish, Norwegian and Danish	440,262	0.88
France	106,971	0.21
Total, native and Anglo-Saxon	49,477,657	98.65
Spanish, Italian, Hungarian, Polish and all others	678,126	1.35
Grand total, as above	50,155,783	100.00

It is evident from these figures that both native and foreign ideas of present tendencies in this country are largely erroneous. For all the large immigration which is coming to this country, its racial characteristics are not sensibly affected by it, even in tendency. What they were a century ago they are in substance to-day, and are likely to remain. So true is this that, even if the entire native-born element in 1880, constituting seven-eighths of the population, and holding and managing nineteen-twentieths of the property probably, could have been wiped out entirely, the foreign-born element alone, with the immigration which has since been coming, would in effect have created a new English-speaking Anglo-Saxon race; we might almost say English race, so near is the proportion of different races to that which formed the original English race, which is by far the most mixed of the British races. The Welsh, Scotch and Irish races are of much less mixed origin than the English, and, moreover, remain persistently distinct on the other side of the water, though they are so rapidly absorbed into the general mass on this side.

WHETHER we like it or not, therefore, this race is really a new English race, and nothing else, being far more nearly so than even the English, Welsh and Scotch on the island of Great Britain will be when they are once thoroughly merged into a homogeneous people, if they ever are. That our branch is somewhat of an improvement on the old stock, Americans naturally believe. It will be an innovation on the past history of mankind if it is not, it having been the rule since the Aryans left Central Asia that the most vigorous and progressive offshoots of the race have pushed farthest west; and this rule has even continued to a large extent on this continent. Whether or not the great Anglo-Saxon race will ever be politically united again, and so dominate the world, is



Yours truly
N. J. Holly

open to question. Stranger things have happened, and in its own history, for this is not the first, nor the second, nor the third time, that the race has been split into two nearly equal and bitterly antagonistic factions for several generations. But whether this is to be or not, we need not assume it to see how poor and paltry it is to stoop to misrepresentation of the comparative achievements of these two great branches of the same race, especially in matters scientific, which are considered by every one of true scientific instincts with cold impartiality, if at all. It is natural that in certain departments each branch of the race should have much to teach the other. It is natural, for example, that England should exceed us in ocean commerce. She has no continent of her own to conquer, and must conquer the sea if anything. On the other hand, it is natural that we should excel in all arts of interior transportation. We have more railways, not only than England, but than all the rest of the world put together. It will be "a cold day" for England, and argue a marked decadence, when we can not only conquer our own continent, but compete with her on equal terms upon the ocean. We did so half a century or so ago, simply because the railway was not then, with its opportunities for internal conquest. We seem to be proving pretty apt scholars now in learning what her broader experience has to teach in marine engineering. It is not altogether a promising or a hopeful sign that technical England, as represented in a leading organ, should find pleasure and comfort in deluding itself by misrepresentations of fact as to its status in the other art, where it is not natural that it should excel. The application of these remarks to recent events we will not make. He that has ears to hear, let him hear.

IN the paper by Mr. R. A. HATFIELD, of Sheffield, England, abstracted in another column, he makes the following comment on the question of the proper name for the (commercially) new metal ALUMINUM or ALUMIN-I-UM:

A recent interesting paper to the American Institute of Mining Engineers, by Mr. OBERLIN SMITH, entitled "Aluminium in Search of a Nickname," refers to the title which should be bestowed on the metal. Whilst hardly agreeing with him that we should come down to the short, but somewhat undignified term "Al," both that of "Aluminium" (adopted in England), or "Aluminum" (as in America), are somewhat awkward. It seems to the writer that as aluminium seems in several ways to resemble silicon, as will be seen from the experiments detailed in this paper, it might be well to name the metal "aluminon." One now seldom hears the old term "silicium," besides which, the affix "ium" belongs to metals with quite distinctive qualities, such as "Sodium," Potassium," Lithium," etc., and it would make our now cheaper but respectable friend fall more in line with the ordinary wording at present adopted. The above suggestion would also meet the objection raised by American friends, who rightly contend that if aluminium is adopted, the oxide should be termed alumina, which no one would defend. The title "aluminon" would, however, meet both cases, as well as proving more euphonic.

It is surely a strange way of avoiding confusion between two different names for the same substance, both in established use, to attempt to introduce still a third name, differing by but a shade from either. What advantage has aluminon over aluminum, unless it be an advantage to compel both nations at once to change their practice instead of one only? It is true, as Mr. HATFIELD states, that aluminum is almost universal in this country, while aluminium is still most common in England. The largest producers in the world, however, favor the form aluminum. Euphony, the genius of the language, which tends to shorten words in common use, the history of the metal and common sense, all favor the form aluminum. It is all but certain to be the one which will ultimately prevail. For these reasons we and other American journals have adopted this form. We trust foreign scientific journals and scientific men will do the same, and so end this confusion.

CHICAGO means to keep in the van in all things typical of rapid progress and new enterprises. It already has the World's Fair of 1892 and a census enumeration that puts it second on the list of great American cities. Then one of its citizens announces with a windy flourish of trumpets—all wind as yet—that he is preparing to produce aluminum at 15 cts. or less per pound, and will soon be able to literally coin the soil under his feet into dollars. Now we are to have an air-ship rapid transit company that will convey passengers around the world in five days, and literally send a man "by telegraph" from New York to Hong Kong. No detail is omitted in the elaborate programme announced by the press of that city. The incorporators and inventors are named, the $20,000,000 "cash" capital is "ready to be paid in," the company will be chartered within 48 hours, the contracts have been let for the construction company—for there is a construction company of course, and the Mount Carmel Aeronautic Manufacturing Company is an actuality. The cars to be transported are to be of the size of Pullmans and carry 50 passengers each, and they are to be made of aluminum manufactured, presumably, on the Chicago plan at 15 cts. per pound. And last, but not least, for judging from the stores of mental phosphorus wasted over it, it is a much more difficult problem than any involved in the flights of Chicago imagination noted above, our Western rival proposes to solve the Brooklyn Bridge entanglement by an endless chain of cars that will load and unload passengers "on the fly;" a solution better adapted to the agile Chicagoan than to the more staid Brooklynite. Verily, there is but one Chicago and the *Times* is its prophet.

Movements of New England Population.

It has been our intention to analyze the tendency of population in the various States and sections of the Union, as revealed by the successive censuses, as fast as the records of the last one became available. We find this so excellently done as respects the New England States in the *Evening Post* of Oct. 6 that we content ourselves with making its article the basis of our own, with some reconstructions and additions to the tables.

The growth of population by States in the last decades has been as follows:

	1880.	1890.	Increase.	Incr. p. c.
Northern Group—				
Maine	648,936	660,261	11,325	1.7
New Hampshire	346,991	375,827	28,836	8.3
Vermont	332,286	332,205	—81	....
Total	1,328,213	1,368,293	40,080	3.0
Southern Group—				
Massachusetts	1,783,085	2,233,407	450,322	25.3
Rhode Island	276,531	345,343	68,812	24.9
Connecticut	622,700	745,861	123,161	19.8
Total	2,682,316	3,324,611	642,295	23.9
Grand total	4,010,529	4,692,904	682,375	17.0

As to this total increase of 682,375 or 17.0 per cent., the *Post* remarks:

So much has been written, and truthfully written, about the exodus of the farming class from rural New England that it is probable that many well-informed persons have acquired the idea that the population of that portion of the country was either decreasing, or increasing very slowly. The census figures show, however, that so far from this being the case, the absolute increase in the population of New England has been greater than in any previous decade since 1790, and that the percentage of increase has been greater than during any previous decennial period since 1850.

The population of New England at each census, the absolute increase, and the percentage of increase during each decade are shown in the following table, which is of notable interest:

Census.	Population.	Increase.	Incr. p. c.
1790	1,008,708	....	....
1800	1,233,011	224,303	22.14
1810	1,471,973	238,962	19.33
1820	1,659,579	187,606	12.74
1830	1,954,717	295,138	17.78
1840	2,234,822	280,105	14.33
1850	2,728,116	493,294	22.07
1860	3,135,283	407,167	14.92
1870	3,487,924	352,641	11.25
1880	4,010,529	522,605	14.98
1890	4,692,904	682,475	17.02

When this tolerably regular table is subdivided into two for the three northern and three southern New England States, respectively, a surprising contrast is found. The northern group formerly grew very fast and now grows very slowly, while precisely the reverse is true of the southern group. The *Post* gives the two following contrasting tables of the growth of these two sub-groups by decades since 1790, bringing out clearly this notable contrast in rate of growth.

Northern New England.

Census.	Population.	Increase.	Inc. p.c.
1790	323,150	....	....
1800	490,042	166,892	51.64
1810	661,060	171,018	34.90
1820	776,257	115,197	17.43
1830	949,435	173,178	22.30
1840	1,078,315	128,880	13.58
1850	1,215,265	136,950	12.70
1860	1,268,086	52,821	4.35
1870	1,275,766	7,680	0.61
1880	1,328,213	52,447	4.10
1890	1,368,293	40,080	3.02

Southern New England.

Census.	Population.	Increase.	Inc. p.c.
1790	685,558	....	....
1800	742,962	57,411	8.35
1810	810,913	67,944	9.14
1820	883,322	72,409	8.93
1830	1,005,282	121,960	13.81
1840	1,156,507	151,225	15.04
1850	1,512,851	356,344	30.81
1860	1,867,197	354,346	23.42
1870	2,212,158	344,961	18.47
1880	2,682,316	470,158	21 24
1890	3,324,611	642,295	23.94

It will be seen that the northern group of States, which is now growing very slowly in population, in the early part of the century grew very rapidly. As for the causes affecting the northern group the *Post* remarks:

Northern New England in 1790 had a population of less than 7 per square mile. There was plenty of room for growth, and, until 1830, it was rapid. For the next two decades, while these States continued to grow, they did so much less rapidly than before. By 1850, although they then had only 25 inhabitants to the square mile, the practical limit of their growth as agricultural, or semi-agricultural, communities seems to have been reached. In the last 40 years their population has increased but 12½ per cent.

There is much more waste land in northern than in southern New England. Cheap railroad and steamship transportation from better soils has made it unprofitable to till lands which a century ago would have yielded a living to their cultivators. The increased use of agricultural machinery has enabled fewer hands to work a farm of the same area. The social attractions of city life are far greater, and are brought much more closely home to the country-raised youth than was the case a century ago. These are doubtless some of the most important reasons why Maine, Vermont, and New Hampshire seem to have stopped in their growth, although they have not to-day 28 inhabitants to the square mile.

While this is all true so far as it goes, we fancy an important cause not noted is, that these States are off in a corner of the Union, and have intimate trade relations with States to the south of them only, instead of with States all around them. In the early part of the century this did not much matter; each community was then perforce sufficient unto itself for the most part. But interstate commerce has now reached vast proportions, and the States not favorably situated for it are inevitably at a great disadvantage, commercially and industrially, and population naturally drifts away from them, just as it is drifting away from Canada to the United States for a like reason. It is probable, if not certain, that the present census will show from a quarter to a fifth of all living Canadians to be residents of the United States.

The Canadians are fond of comparing the growth of Maine with that of their maritime provinces, and find comfort in the fact that Maine also does not grow very fast; but they do not realize that its very vicinity to those provinces, with which it has only very limited trade relations, is in great measure blighting its growth, as the provinces are blighted by isolation. Maine is not suited for a very dense population, its northern part being a mere barren waste; but there can be little doubt that were it situated where New Jersey is, for example, remaining in other respects the same, it would have several times its present population and wealth.

We may at a later date test the correctness of this theory by bisecting these three Northern States

by an east and west line and comparing the north and south subsections as North and South New England are compared above. As to its essential correctness there can be little doubt.

As to the growth of Southern New England the *Post* comments as follows:

In the closing years of the last century and the early decades of this, Southern New England was, as to growth, in a condition very similar to that which now exists in Northern New England. In Massachusetts, Rhode Island and Connecticut there were in 1790 already 49 inhabitants per square mile, or more than there are to-day in any State west of the Mississippi or south of the Potomac or the Ohio. Under the then existing conditions, it was not possible for many more people to find support from the soil, and until the great development of manufacturing came, the increase in southern New England, and especially in Connecticut and Rhode Island, was very small. From 1790 to 1800 the population of Rhode Island increased but 297. In the first half century of national existence, Connecticut's population grew only 30 per cent., as against an increase of 140 per cent. in the second half. With the great development of manufacturing subsequent to 1820, the rate of growth of the southern New England States perceptibly increased. Since 1840, when the great tide of foreign immigration which set in about that time was attracted to these States by the opportunities for employment held out by their mills and factories, their percentage of increase has been high.

When we consider that a perfect flood of emigration from New England, the like of which the world never saw before, has been pouring out into every other State in the Union for the past half century, it is evident that even the average increase of New England, still less that of the three most southerly States, could not be maintained by any known rate of natural increase without a good deal of foreign immigration. At the last census there were no less than 587,039 persons *born* in New England, not to say of New England descent, living in other States of the Union, being about one-fifth as many as were living in New England. As an average these could hardly have been away from New England more than 10 or 12 years, indicating that from 50,000 to 60,000 of native-born New Englanders were emigrating to other sections annually, out of a population of about 4,000,000. To show more clearly the general tendency of New England population, we have compiled from the last census (with an amount of labor altogether disproportionate to the size of the table, since these records were not given in very convenient form in the last census), the following little table showing for north New England and south New England separately the general tendency of population in 1880. A like record for 1890 will be interesting when accessible.

MOVEMENTS OF NEW ENGLAND POPULATION, 1880.

	Then living in		
Where born:	Northern N. E.	Southern N. E.	All N. E.
Home born	1,110,803	1,739,208	3,056,385
Elsewhere in N. E.	43,049	163,325	
" in U. S.	28,225	132,307	16,532
Foreign born	146,136	647,476	793,612
Total population	1,328,213	2,682,316	4,010,529
Emigrants living in other parts of the U. S.	272,447	314,592	587,039

It will be seen that there was up to 1880 a very trifling movement into northern New England from the outside world, even of foreign born, despite the propinquity of Canada: 83½ per cent. of its population was home-born, against only 65 per cent. in Southern New England. The foreign born was 11 and 24 per cent. respectively, while the native born emigrants from other States into the two sections were only 5½ per cent. of the total population in Northern New England against 11 per cent. in Southern. Only 71,000 Americans had condescended to move into northern New England from other States, while 163,325 had left it for southern New England, and 272,447 for other States of the Union. The figures given at the beginning of this article indicate that these tendencies have continued during the last decade with increasing force.

Diagonally Through Russia.

[EDITORIAL CORRESPONDENCE.]

Before attempting to describe some of the experiences of a 1,500 mile railway journey diagonally across Russia, from Vladikavkas, in Daghastan, to St. Petersburg, it might be well to explain how we got to this first named somewhat remote starting point, near the shore of the Caspian Sea. The Southeastern Russian railway system ends, or begins, as the traveler finds it, at Vladikavkas, south of this, the mighty chain of the Caucasus bars the way into Asia, and there is as yet only one wagon road across the mountains, the famous Russian military road built through the Dariel Pass and beyond to Tiflis, which we shall further describe.

In a previous letter we were en route to Constantinople. From there we had originally intended to go direct to the Caucasus and pass over to the Caspian Sea by way of the Batoum and Baku railway. But the appearance of cholera in Egypt and Asia Minor and its rumored entrance into the region of the Caucasus by way of Persia, changed our plans and we crossed the Black Sea to Odessa. Finding at the latter place that the Russian officials denied the rumors and ascribed them solely to Turkish jealousy and moral obliquity, we determined after all to go at least as far as Tiflis and again turned our faces eastward. We skirted the Crimea and the north coast of the Black Sea, as far as Kertsch, at the mouth of the Sea of Azof, and in four days arrived at Batoum, at the east end of the Black Sea, just in time to catch an eastbound train.

We found on this, our first experience on a Russian railway, cars of a similar character to those to be later described; they were hauled by an engine burning petroleum refuse on the large scale which has been often described in these columns. There was little or no smoke, but an all-pervading odor of petroleum that was not exactly pleasant. On the sidings and on the main line we saw abundant evidence that the transport of the product of the Baku oil fields was the chief business of this line. And we also noticed, when we neared the summit of the line, at the Suram Pass, that the much talked of oil pipeline on this road commenced on the east side of the pass and simply crossed this summit and required a reloading into tank-cars on the west side, instead of passing on down to the sea as it could easily do. In other words, the State owns the railway, and the authorities do not propose to cut off their most profitable source of income by granting concessions for a through pipe line for oil transit from Baku to Batoum.

The distance to Tiflis was about 190 miles and it required just 14 hours of travel, an average speed of about 13½ miles per hour, with only the regulation stops at stations. The novelties in scenery and people seen in this trip through the most striking portion of Trans-Caucasia cannot be treated of here, and of some of the engineering features passed en route we will speak again.

It is sufficient to say that we reached the quaint old city of Tiflis about 11 P. M., and were driven, somewhat to our surprise, to a most excellent hotel. Tiflis is a city of most ancient lineage, many masters and many people; it has been ruled in turn by Georgians, Persians, Turks and Russians, and the latter "protect" it now. As a consequence of its many-sided history its present population is made up of Armenians, Georgians, Russians, Persians and Tartars, the races predominating about in the order given. A colony of Germans, of about 1,500 in the total of 100,000 souls, already has its beer brewery and two beer-gardens in active operation in this Asiatic province.

At Tiflis we found that there was cholera at Baku, and much against our inclination we were compelled to forego the pleasure and profit of an inspection of the wonderful oil fields of the Caspian shores, under the penalty of a possible 20-day quarantine on entering Russia again. As we did not want to go back on our track it was determined to cross the Caucasus by the Dariel Pass and thus reach Vladikavkas, the extreme southeastern terminus of the Russian railway system. And the trip across the mountains fully repaid us for the lost trip to Baku, and is worthy of a more complete and glowing description than can be here attempted.

In the first place, there is but one road over the whole main chain of the Caucasus, which abuts on the Black Sea with sheer and inaccessible face and preserves an almost unbroken high elevation to the shores of the Caspian. At the latter point alone the axial slope becomes more gentle, and, excepting at Derbend, narrow plains skirt the sea shore and make it possible to pass along the west shore of the Caspian by highway or railway. But for traffic this east end of the mountain is too remote, and as soon as the Russians had completely subjugated the wild tribes holding these mountain passes and valleys they built the existing military road from Vladikavkas, in Daghastan, to Tiflis, on the Asiatic side of the mountains by way of the long-famed Dariel Pass.

This road is a remarkable piece of engineering, and in the thoroughness of its construction and the difficulties surmounted shows the determination and power of a people that had come to stay. Commencing at the Tiflis end, it soon begins to ascend the mountain with gentle gradients, well macadamized roadbed and substantial stone arch bridges over the various affluents of the river Kur. Until the summit is almost reached, nearly 8,000 ft. above the level of the Black Sea, the scenery is rather beautiful than grand. Quaint villages with ancient churches and monasteries line the road, old castles of a now impoverished or extinct Georgian nobility appear, and the many well cultivated fields show a seeming prosperity under Russian rule. The mountain sides are of comparatively gentle slope, and are crowned with foliage, and lakes now and then lie in the hollows. But as we ascend higher and more nearly approach the watershed of the main chain, we find ourselves confronted by a lofty range of snow-clad peaks that are at points higher than the highest of the Alps, and which in beauty of coloring, in purple tints and flashes of light from great glaciers winding down the furrows in these peaks, surpass almost anything that Switzerland can present.

The dividing line between Europe and Asia is passed at Krestowaja Gora, or Mountain of the Cross, at an elevation of almost 8,000 ft., and this is the lowest natural pass in the range. The scenery almost immediately changes and becomes grand in every sense of the word. While the secondary mountains on the south side are mainly limestone, on the north side granite and basaltic lava form nature's skeleton, and there is little in the way of earth or verdure to cover the bare ribs. The Terek River, small at first, but rapidly growing from the contributions of melting snow and glaciers, goes rushing northward with a dynamic power, that for almost 40 miles has cut a deep, narrow trench through the earth's crust, in places bounded by sheer walls of black rock over 5,000 ft. high. This deep and narrow gorge is the Dariel Pass proper, famed even in PLINY'S day, who describes the pass as actually closed by a fortified gate, a measure which might easily have been adopted. Along this gorge the road is carried on a shelf hewn out of the solid rock, with the normal mass overhanging and a low wall only separating the traveler at times from the boisterous Terek hundreds of feet below. The basaltic lava that in great part forms this mountain pass adds an element of weirdness to the scenery that is peculiarly its own. The hexagonal prisms, ranging up to several feet in diameter, stand up like monster organ pipes or radiate fan-like from a center, and the weathering of this peculiar rock has caused it to shoot up in sharp needles against the blue sky and to assume all manners of fantastic shapes. In one place a most realistic monster of dragon-like form and several hundred feet in length came sprawling down the mountain side with its ugly head buried between its fore paws. In fact pen cannot describe the beauties, the wildness and the weirdness of this wonderful freak of nature and we will not attempt it.

The methods of traveling across this 130 miles of mountain road are also peculiar and worthy of note. One Government mail coach, and sometimes two, pass over this pass each day. But as each coach only carries four passengers inside and three in a hooded seat in front, and as the latter place is the most popular and is taken for weeks in advance, we were forced to select the more expensive *arantas* or private conveyance. The Government provides the coach and horses and drivers, and at the ten stations for changing horses on the line has built very respectable stone station-houses for the convenience of the traveling public. Good meals and good beds can be had here, for though the traveler can push

forward and cross the mountain in 24 hours, if circumstances make it necessary and weather permits, two days are usually consumed in transit. In our case we went to see, and started from Tiflis in a double-seated carriage with four horses abreast, a driver and an Armenian interpreter, the latter absolutely necessary to take us through the Babel of tongues that we encountered on the way. Horses and drivers are changed at each of the ten stations, and so were some roubles in the way of "drink-money" to each departing Jehu and to the Tartar-boy who changed the horses.

Drivers and horses varied in their degree of recklessness, especially in passing down the steep slopes and around the sharp turns of the northern side of the mountain, and our Armenian was eminently useful in keeping the lazy driver up to the mark, and in checking the too impulsive nature of some other wild natives of Daghastan. It was well, perhaps, for our moral peace that we did not understand the wild shrieks of the driver and our Armenian henchman during some of their more animated discussions. But "John" always prevailed, either by force of argument or by virtue of fierce looks, backed by the persuasive eloquence of an ugly looking Daghastan dagger and a revolver of modern type that he ostentatiously carried swung to his belt of silver neillo-work. Traveling in the manner we did beat vestibule train prices out of sight. It cost three of us about 160 roubles, or $96 to travel this 130 miles. But this sum included a carriage, the hire of 40 horses and 10 different drivers, the expenses of our dragoman for the round trip, and his and our own meals for two days, and one night's lodging at the summit station. We certainly got a great deal for our money. We thus landed at the railroad at Vladikavkas after a trip which, for varied interest, is almost unsurpassed.

[TO BE CONTINUED.]

CORRESPONDENCE.

Bear Valley Dam.

CLARKSBURG, W. Va., Oct. 1, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Being interested in Mr. H. MEDWAY MARTIN'S article in last week's NEWS on "Strains in Curved Masonry Dams," I wish to call his attention and others' to a fact connected with the construction of the Bear Valley dam which seems to have been overlooked, namely, that during construction water was admitted from time to time into the basin above, thus compelling the masonry to set under static water pressure and permitting the floating of materials on rafts to the places needed.

This surely is a sufficient reason for that "first plastic yielding" which has enabled the dam to withstand such immense pressure as it does; and it seems to the writer, wholly incorrect to make a mathematical investigation of this particular structure on the assumption of a perfectly elastic solid *ab initio*.

I hardly think Mr. MARTIN is in error when he says that experience shows that masonry will stand considerable deflection before cracking when it takes place slowly, and it should be remembered that not only has the Bear Valley dam set *slowly*, but also under *uniformly augmenting pressure*. Is not this, Mr. Editor, the true explanation of the stability of this bold structure?

BURR BASSELL.

[Without attempting to answer definitely the interesting point raised by our correspondent we suggest that the dam was building from July 1 to Dec. 1, 1884 [ENG. NEWS, June 23, 1888], and that, while water was expressly admitted to let the masonry set under pressure so far as possible, yet that it must have been subjected to so little pressure before it was practically set that this effect could have amounted to very little. The average construction was less than 13 ft. vertically per month, so that the cement would be set nearly as hard as it ever gets to be before it was subjected to more than 3 ft. to 5 ft. head of water.—ED. ENG. NEWS.]

The Lawrence Scientific School.

HARVARD UNIVERSITY, LAWRENCE SCIENTIFIC SCHOOL, CAMBRIDGE, MASS., Oct. 2, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Your issue of Sept. 13 contains some remarks on the Lawrence Scientific School which are so much at variance with the facts as to call for correction.

As your reviewer says, this school was one of the first of its kind established in this country; but he falls into serious error in stating that it was, or is, liberally endowed. Indeed, if it had not been aided by the funds of the college with which it is connected it would never have been able to do the work which it has done.

The opportunities for engineering education have not been "wasted," as is shown by the number and success of the graduates in engineering; nor is the school "in a state of ridiculous decadence," the fact being that the number of students at present in the school is greater than ever before.

There has been a discussion as to whether the school should be discontinued as a separate organization, as your reviewer states; but it has been decided to continue the school, to develop it as rapidly as possible and to support it with all the resources of the University.

I regret that your reviewer has fallen into such grave errors, and that these errors have been spread so widely through your agency. I trust you will cause a thorough examination of the facts to be made by some impartial person. We shall be glad to have the facts when determined made public through your widely read journal.

W. S. CHAPLIN, Dean.

[It occurs to us, as it may to others, that the number of students in the Lawrence Scientific School might well be very much "greater than ever before," and the school still be in a comparative "state of ridiculous decadence" when its age and opportunities are remembered. The request for investigation, however, is a fair and proper one. We shall make it, and pending such investigation refrain from further comment.—ED. ENGINEERING NEWS.]

Creosoting Open-grain Timber.

FERNANDINA, Fla., Sept. 30, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have read with a great deal of interest the report of Mr. H. W. REED to the American Roadmasters' Association on the preservation of cross-ties in your issue of Sept. 20. As I have had practical experience in creosoting for a number of years, I beg space in your valuable paper for a few remarks on Mr REED'S report.

It is very desirable to use for creosoting well seasoned and open-grain timber, but this is almost impossible in this country as far as well seasoned timber is concerned. The creosote works have to use lumber freshly cut at the mills, and piles cut only a few days, or perhaps weeks, before creosoting. In only very few instances is it possible to obtain seasoned material.

As far as the open-grain timber is concerned, creosote works are very often prevented from using such material on account of the specification given by the engineers, who require either all heart or allow only a very small amount of sap. It is next to impossible to force the oil in all heart timber to any perceptible depth. The heart of a tree is the part which has been completed by nature, and there is no room left for any preservative to enter. If this room is artificially produced, by subjecting the timber to high temperature, it is at the expense of the strength of the timber and may render it unfit for the purpose it is intended.

Speaking of the expense of the creosoting process, it would be well to bear in mind that that part of the process during which the unseasoned timber is prepared for the reception of the preservative occupies by far the longest time of the whole process. The artificial seasoning of the timber consists of the evaporation and removal of the moisture and sap and the coagulation of the albumen, which is accomplished by heating and steaming the timber under pressure, and by withdrawing the vapors through a powerful vacuum pump. Mr. REED'S suggestion to use a combination of preservative agents, of which creosote is one, for cheapening the process, does not seem practical to me as long as unseasoned timber has to be used. Should sulphate of zinc be injected first it would have to be done under a temperature lower than is required to evaporate the sap and moisture and to coagulate the albumen. Before the creosoting could be done effectually the temperature would have to be raised so high and a high vacuum maintained so long, that the sulphate of zinc would be removed from the timber. Several years ago Mr. O. CHANUTE tried a combination of preservative agents, of which creosote was one. It would be of a great deal of interest if Mr. CHANUTE would make public his experience in that direction. Yours very truly,

B. E. BURCHARDI,
Chief Engineer and Superintendent, The Creosote Lumber and Construction Co.

Aluminum Steel.

Probably no invention or discovery relating to metallurgical processes since the invention of the Bessemer converter has deserved or attracted more attention from the public than the recently developed methods of reducing aluminum. The announcement that aluminum-bronze could be had at a very small price, followed by a notice that nearly pure aluminum would be sold at an extremely low rate compared with its former value, was a signal for wildly speculative leaders in the daily newspapers, which have done much harm, probably, by spreading a general belief that it possesses those leading characteristics of iron which make the latter the most useful of metals. Undoubtedly the new product is very valuable for purposes requiring non-oxidizing surfaces or extreme lightness compared with ductility, but many of the claims advanced for it by unscientific persons are simply ludicrous. The leading properties of the metal and its alloys with copper have been thoroughly described by Capt. A. E. HUNT (see ENGINEERING NEWS, Feb. 22 and March 1, 1890) and many of the principal facts regarding aluminum-bronze may be found in the issue of this journal published Feb. 8, 1890. It remained for Mr. R. A. HADFIELD, of Sheffield, England, to investigate the properties of aluminum-steel and determine what are the actual characteristics of this alloy, which many writers declared would change our methods of construction so greatly. We give below a full abstract of his paper on "Aluminum-Steel," presented to the New York Convention of the American Institute of Mining Engineers.

CAST ALUMINUM STEEL.

Melting.—The material obtained for these experiments was produced by melting in crucibles, in the ordinary manner, good wrought bar iron, and adding the aluminum (about 98% Al), manufactured by the Pittsburg Reduction Co.'s system, sortly before teeming. The writer takes this opportunity of expressing his thanks to Captain HUNT, one of the directors of the Pittsburg Co., for a liberal supply of the metal for experimental purposes, and as the company in question was probably the first to sell the metal under 10s. per lb., it is to be hoped that the Hall system will meet with increasing success.

Although a difficult one, the object was to obtain an alloy or compound consisting as nearly as possible of aluminum and iron alone. In the material made it will be found that the other elements present do not amount to more than 0.50%, so that this intent may fairly claim to have been accomplished. The ingots, 2¼ ins. square, were reduced by forging in the ordinary manner to bars 1⅛ ins. in diameter.

The consideration of the qualities of these alloys is divided into two heads: first, the material in the *cast* second, the material in the *forged* state.

Cast State.—Nothing special was noted during the melting operations, but in all cases upon adding the aluminum "coruscation" was observed. This evolution of heat and light has also been observed when alloying aluminum with copper. Does not this tend to indicate that aluminum added to iron produces true compounds and not merely alloys, as it is well known in laboratory operations that the evolution of heat during the mixture of two substances is often a sign of chemical union? The curious properties of manganese steel seem especially to prove that such a material is a true compound, and no doubt aluminum steel may be classed under the same head.

Fluidity.—It is doubtful whether aluminum increases the fluidity of properly made steel, but if it does, the apparent increase or evolution of heat just referred to seem to the writer far more likely to account for any increase of fluidity that may occur rather than to the so-called lowering of the melting point. This is discussed more fully a little farther on.

As the aluminum increases to large amounts, over about 0.50%, the metal becomes quite thick, "creamy," and sets quickly. No doubt this is partly caused by a considerable portion of the aluminum being oxidized to alumina and becoming entangled as slag, in the same way as occurs when silicon is oxidized to silica. Unless suitable flux is present, this excess of oxide cannot be carried off, the molten metal becomes less fluid, and causes the "thickness" noticed. There is a resemblance in this respect to the action of high percentages of silicon added to iron. When exceeding about 0.75% Al., the molten material so rapidly "creams over" on the surface that the production of sand-molded articles is only effected with difficulty; in fact, it was only by using considerable care that the cast test bars were obtained. (Mr. KEEN, even with cast iron, found a decided decrease in fluidity by the addition of aluminum.) It must not be overlooked that the writer is here referring to comparatively high percentages. So far as his own experiments have gone, aluminum, as regards lower percentages, also acts in a similar manner to silicon under the same circumstances.

So much has been said as to aluminum lowering the melting-point of iron that the writer wonders how and why this statement was originated, as it certainly seems to have no foundation in fact. This is confirmed by M' OSMOND, who by means of the "Le Chatelier" pyrometer kindly made for the writer a special determination as to the melting-point of an alloy containing 5% Al and about 94½ % Fe. The sample in question did not show the slightest signs of fusion until a temperature of 1,475° C. was reached. As mild steel by the same pyrometer was shown to fuse at about 1,500° C., there could, therefore have been little or no lowering of the fusion-point; and if this is the case with an alloy containing 5%, still less can it be so with one containing only 0.10%, which is the quantity usually

described as being present when the so-called lowering-point is supposed to occur. It is especially satisfactory to have the testimony not only of M. OSMOND, but that of Mr. H. M. HOWE, who both agree with the writer on this point.

In the writer's opinion, if any increase of heat or fluidity takes place by the addition of small amounts of aluminum, it may be due to either of the following causes, or to both combined. First, there may be evolution of heat owing to oxidation of the aluminum, as the calorific value of this metal is very high—in fact, higher than silicon. According to BERTHOLLET, the conversion of aluminum to Al_2O_3 equals 7,900 cals.; silicon to SiO_2 is stated as 7,800.

Secondly, and more probably the correct explanation. As proved in a very clear and able manner by Mr. GALBRAITH in his interesting paper to the Iron and Steel Institute in May, 1890, the fluidity of molten iron and steel depends not only upon the amount of heat imparted by external means or by oxidation, but often upon the quantity of intermingled slag or oxide of iron. He found that in certain cases in excessively over-oxidized steel, although the heat of the furnace was *more* than usual, the product was still lacking in fluidity. It would be interesting to have the point followed up and thoroughly tested by means of the "Le Chatelier" pyrometer. As supporting this, it may be observed that the well-known German metallurgist, LEDEBUR, believes the rôle of aluminum "to be no other than that of destroying the dissolved oxide of iron present."

The loss of the metal in melting is variable, but in nearly all cases amounts to a considerable proportion of the percentage added. The writer has seen it stated that there is no loss, although at the same time it has been mentioned that a considerable scum of alumina was noticed. The two facts are inconsistent, as if the latter was present it would appear that of necessity more or less of the metal added must have been oxidized, and consequently not present in the final product.

Soundness.—Does the addition of aluminum produce sounder material than silicon, manganese or silicon combined with managanese? Whilst it has been found to act powerfully in this respect like these metals, still it does not follow, as much of the literature on the subject would have us believe, that blowholes are quite done away with, and that the steel-founder may come down to his works in the morning without paying the usual visit to the scrap heap. The art of the steel-founder is not merely the production of sound steel, which, by increased knowledge and choice of alloys for producing soundness, is, whilst still complicated, not so difficult as formerly, but consists, amongst other things, in the careful attention to the preparation of the molds into which the molten steel is poured. There is no rapid or royal road to the production of sound steel castings; this is only attained by long experience, combined with specialized knowledge. Mere attention to the chemical composition of the steel will not produce the desired results; and the writer hopes that these words will be remembered by those who are anxious to embark in the production of steel castings, and who consider from reading certain literature that it is perhaps only necessary "to buy so much aluminum, add 0.10%, lower the melting-point, and the result will be perfection.

One cannot be surprised that strong hopes are raised when ill advised trade pamphlets make such statements that by the addition of aluminum to iron, *nine* distinct

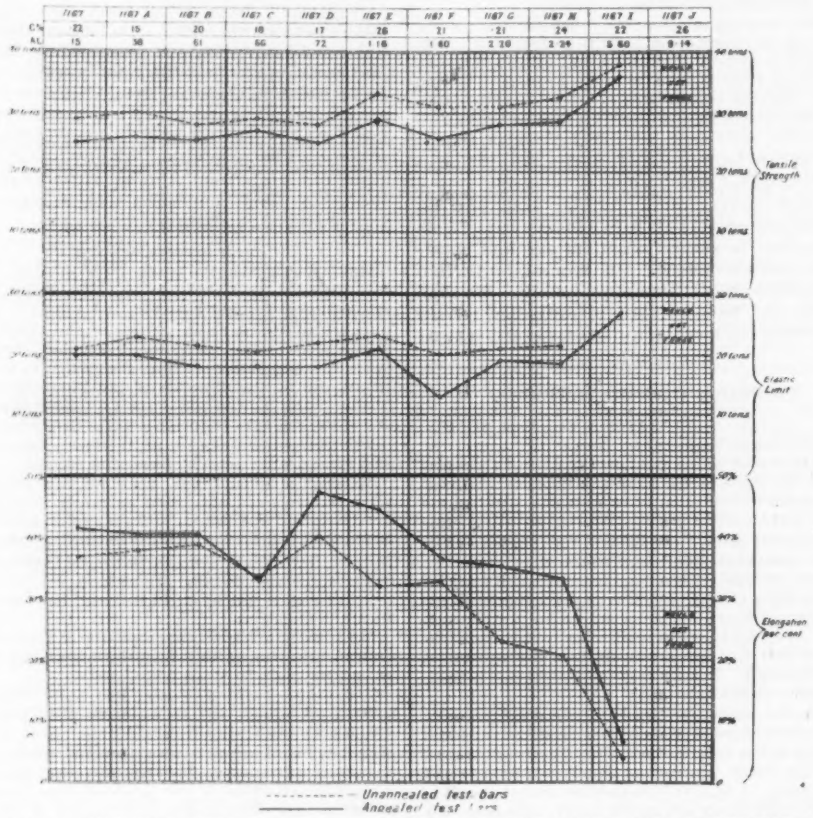


DIAGRAM 1.—SHOWING THE TENSILE STRENGTH, ELASTIC LIMIT AND ELONGATION PER CENT. OF ANNEALED AND UNANNEALED FORGED ALUMINUM STEEL.

and important qualities are at once conferred. The writer, too, has seen specimens of so-called ferro-aluminum sold at shillings per pound, but which upon analysis gave "Nil" Si, S, 0.24%, Ph, 0.30%!

As high as 0.75% aluminum, or even more, may be admitted without much interference with the ductility or toughness of the cast specimens. Experiments prove that more aluminum may be present in the cast material than silicon in cast silicon-steel before brittleness sets in. After reaching the region of brittleness, and by adding still higher percentages of aluminum, there is no return of strength—on the contrary; so that this material in no way resembles the curious property noted in this respect with regard to manganese-steel.

Aluminum seems specially powerful in absorbing gases and in Mr. RICHARDS' book on the metal he states that M. DUMAS found on heating it in a vacuum that towards a red heat considerable quantities of gases were given off, their composition being 88 c.c. H, and 1.50 c.c. CO_2.

TABLE I.—COMPARISON TABLE OF FORGED AND ANNEALED SILICON AND ALUMINUM STEEL.

	Per cent. C.	Si.	Al.	Cold bending test of annealed forged bars.
Si Steel	.14	.24	....	Bent double.
Al steel	.15	....	.38	Bent double.
Si steel	.18	.73	.73	Bent double.
Al steel	.18	....	....	Bent double.
Si steel	.19	1.60	....	Bent double.
Al steel	.21	....	1.60	Bent double.
Si steel	.20	2.18	....	Bent double.
Al steel	.24	....	2.24	Bent double.
Si steel	.26	5.53	....	Would not bend.
Al steel	.22	....	5.60	16° broken.*

*Test bar broke in the threads during last two tests.

Bending Tests.—Table I. gives the bending tests, from which it will be seen that the annealed samples up to 0.85% bent double cold; those unannealed were not so good. The gradual increase of aluminum is very clearly shown to reduce the toughness both of the unannealed and annealed specimens.

Hardness.—As might be expected from the soft nature of the metal aluminum, its addition to iron does not add materially to the hardness, again in this respect resembling the effect of silicon. Seven to eight per cent. cast aluminum-steel may be readily drilled and filed. This point is dealt with more fully under "hardness" in treating of the forged material.

Neither does its addition, unlike manganese, interfere with the magnetic susceptibility of the iron present. Experiments are in hand to determine what is the actual effect in this direction, and also as regards conductivity.

Appearance of Fracture.—Aluminum in the cast specimens opens the grain, *i. e.*, increases the size and coarseness of the crystals, and as the higher percentages are reached it is somewhat difficult to distinguish the fractures from those of cast silicon steel. The crystals in the 5% and upward specimens become very large and cleave somewhat after the nature of spiegeleisen. This accounts for the increasing brittleness of the cast material, and neither the fracture nor the brittleness accompanying it in such samples can be changed by annealing. A curious fact was noticed, viz., that the freshly broken fractures had a pronounced odor of sulphureted hydrogen, although the sulphur present did not exceed more than 0.06%. This remained for several days.

FORGED ALUMINUM STEEL.

Malleability.—As high as 5.60% aluminum may be present before malleability ceases; this is about the same limit as in silicon steel.

It may be pointed out as regards the specimens under discussion that they are very low in manganese. Notwithstanding this, the malleability is satisfactory.

Mechanical Properties.—As regards bending qualities, Table II. shows the results. Up to 2.24% aluminum the annealed samples bent double cold, but upon reaching 5% a great diminution of strength takes place, and annealing practically produces no effect.

In the testing machine it will be seen (from Diagram I.), that the elongations, although in some cases irregular, are high, the annealed samples showing, as might be expected, the better results. The samples were all tested on

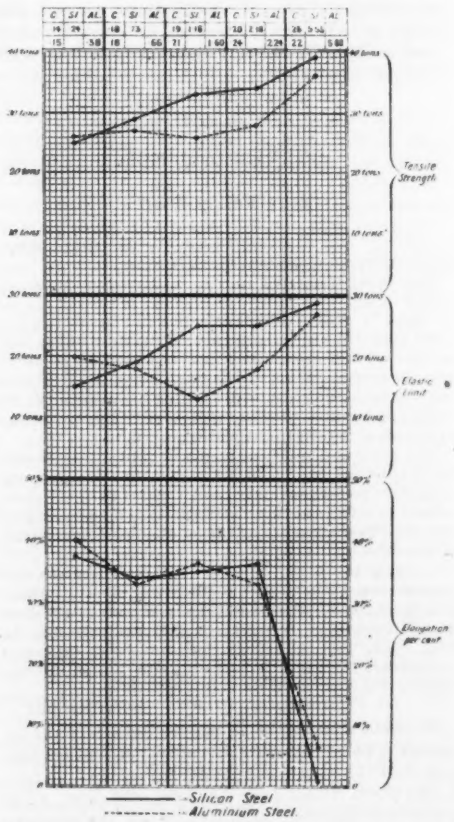


DIAGRAM 2.—Showing Comparison between Forged and Annealed Silicon and Aluminum Steel.

short lengths, 2 ins. (Whitworth standard pattern 0.7979 in. diameter, 0.50 in. area), and the elongations are very good in those up to about 1½% of aluminum; afterward a gradual diminution occurs. This is brought out graphically in Diagram I., and Diagram II. may also be of interest as showing the effect of similar percentages of silicon and aluminum. Comparing the sample of aluminum-steel containing 1.6% aluminum and 0.12% carbon with silicon-steel of 1.60% silicon and 0.19% carbon, the former has an advantage in elongation of 1%. A characteristic of the aluminum steel is that the reduction in area is greater; in this respect it seems to resemble chrome steel. There is, however, considerable difference in the tensile strenth of the two alloys, the aluminum steel being several tons less. The same remark applies to the permanent set point, which in the annealed aluminum steels is fairly low. One difference clearly brought out is that the tensile strength of iron is not increased so much by an addition of aluminum as of silicon.

TABLE II.—BENDING TESTS OF CAST AND FORGED ALUMINUM STEEL.

Mark referred to on Diagram I.	Al. %.	Cast. Size of bar, 6″ × 1″ × ¾″		Forged. Size of bar, 4″ × 11-16″ × ⅝″.	
		Unannealed.	Annealed.	Unannealed.	Annealed.
1167	.15	79° broken.	Bent double.	Bent double.	Bent double.
1167 A	.38	Bent double.	Bent double.	Bent double.	Bent double.
1167 B	.61	174° unbroken.	Bent double.	Bent double.	Bent double.
1167 C	.66	88° broken.	Bent double	Bent double	Bent double.
1167 D	.72	50° broken.	Bent double	Bent double.	Bent double.
1167 E	1.16	31° broken.	54° broken.	Bent double.	Bent double.
1167 F	1.60	28° broken.	133° broken.	Bent double.	Bent double.
1167 G	2.20	Would not bend.	43° broken	Bent double.	Bent double.
1167 H	2.24	16° broken.	32° broken.	Bent double.	Bent double.
1167 I	5.60	*Would not bend.	*Would not bend.	15° broken.	16° broken.
1167 J	9.14	*Would not bend.	*Would not bend.	Would not forge.	Would not forge.

*Very brittle.

In two exceptional samples the writer was able to get the carbon down to as low a point as 0.10% with aluminum, 0.25% and 0.96% respectively (these, not forming a part of the series, are not included in Diagram I). The elastic limits of the two annealed specimens were respectively 13 and 11 tons, breaking loads 23 and 22.5 tons (per square inch of original area, very clearly showing the slight influence of aluminum both upon the elastic limit and breaking load.

It has been stated that very small percentages of aluminum considerably raise the limit of elasticity. It will be seen from the table of tests, and specially from the two almost carbonless samples just quoted, that this increase is slight, if any, as compared with ordinary steel, and also that aluminum does not raise the elastic limit so much as silicon. Seeing that aluminum is an exceptionally soft and malleable metal, possessing a tensile strength of 8 to 10 tons, it is hardly to be expected that this should have been otherwise, and it is a pity that such incorrect statements as above mentioned are started without foundation in fact. The elastic limit of samples should always be determined on annealed specimens, as by cold forging or rolling the elastic limit of even mild steel can be readily raised several tons per square inch; and it would hardly be correct to call this the normal permanent set of the sample under examination. Aluminum and silicon therefore stiffen iron but little, whilst carbon, chromium, tungsten, manganese and nickel clearly increase rigidity; and this from their nature and hardness might be expected.

TABLE III.—COMPRESSION TESTS OF UNANNEALED ALUMINUM STEEL.

Total Load 100 *tons per sq. in.*

Al. %	Length before being tested. Inch.	Diameter before being tested. Inch.	Reduction in length. %	Diameter after compression Inch.
.15	.9970	.7970	51.00	1.2771
.66	1.0025	.7965	49.077	1.1735
1.16	.9085	.7960	47.22	1.1324
1.60	1.000	.7972	48.10	1.1448
2.24	1.0011	.7969	45.40	1.1145
5.6	.9992	.7066	36.57	1.0378

Compression Tests.—Several samples were each subjected to a compression stress of 100 tons per sq. in. Table III. gives the full details. It will be noticed that whilst the specimen containing 0.15% Al shortened 51% in length under the above-named stress, that containing 5.60% Al shortened 36%. Thus even the soft metal aluminum has to some, though very slight, extent stiffened the metal.

Hardness.—As might be expected from the soft nature of the metal aluminum, its addition to iron does not confer appreciable hardness when in either the forged or cast state. In this respect also it resembles silicon steel. The forged material containing 5% is very soft, easily drilled or filed.

The action of aluminum may therefore be classed along with that of silicon, sulphur, phosphorus, arsenic and copper, as giving no increase of hardness to iron, in contradistinction to carbon, manganese, chromium, tungsten and nickel. Water-quenching upon either forged or cast aluminum steel (in which carbon is practically absent) seems to produce no effect, the samples when dipped at even a welding heat being almost unchanged. It has been stated that the influence of aluminum on high carbon or tool steel is to destroy its hardening action. This is quite incorrect; the writer has prepared steel containing 1½% aluminum and 1% of carbon, which hardens sufficiently to scratch glass. It is a pity such inaccurate statements are circulated.

Fracture.—Aluminum causes the tough percentages both in the cast and forged material to break with dark fibrous fracture, similar to wrought iron of good quality, only much darker in color. This appearance in some of the specimens is very curious, as small patches of bright, fine crystals are to be seen surrounded by a remainder of black and dark fibrous material.

In several of the tested tensile specimens a rough and ribbed surface is noticed, proving looseness of texture.

Weldability.—Samples B (0.61% Al), D (0.72% Al), and C (2.20% Al) of Table II. were tested for welding, but unsuccessfully. It would be interesting to try electric welding.

The writer has always found that these special steels, or alloys, such as silicon, manganese or chromium steel, have slight, if any, welding properties.

Application.—Speaking generally of the application of aluminum to the manufacture of iron and steel, the usual amount stated to be requisite for producing good results is about 0.10%; but in many cases, as already pointed out, this would be too little. Supposing, however, that an average percentage of 0.10% or 0.15% was necessary, and assuming the aluminum to be sold at 8s. per lb., the expense of such addition would mean an extra cost of 18s. and 27s. per ton, respectively; where as if as much as even 0.50% of silicon is required to do the same work, it does not cost more than 4s 6d. per ton. On a large output of steel castings this means a serious difference, and in the above nothing is credited to the latter method by the gain of adding so much ferro alloy, which afterwards counts as steel.

In making these statements, the writer in no way wishes to disparage the efforts of those who have devoted so much time and attention to the production of aluminum. Let it be rather an inducement to produce the metal more cheaply. If aluminum can eventually be brought to compete in price with existing alloys, there is a probability of something being done in introducing its use on a larger scale. Aluminum may find a use for certain special purposes, such as in higher carbon steel, where silicon does not seem to act so powerfully in producing soundness as in the case of milder steel with carbon 0.50% and under.

Therefore, whilst for some special purposes aluminum may be employed in the manufacture of iron, at any rate with our present knowledge of its properties this use cannot be large, especially when taking into consideration the fact of its comparatively high price. Its special advantage seems to the writer to be that it combines in itself the advantages of both silicon and manganese; but so long as alloys containing these metals are so cheap and aluminum dear, its extensive use seems hardly probable.

[It will be observed that Mr. HATFIELD'S interesting investigations did not extend to the question of rendering iron and steel incorrosive by a percentage of aluminum, which is one of its most promising fields for usefulness.—ED. ENG. NEWS.]

As a result of the examination Mr. FTELEY calls attention to three possible sites for the dam:

No. 1. At the Quaker Bridge site.

No. 2. At "Cornell's," 1¼ miles above Quaker Bridge.

No. 3. A site a little less than one mile below Croton Dam.

The Cornell site presents several favorable features. At that point the width of the valley at high water line is 1,736 ft., the greatest depth at which the rock is found is 23 ft., nearly 40 ft. higher than at Quaker Bridge; the earth excavation necessary at that point is larger, but it would take place at such a distance from the river as not to be in the way of the greatest freshets. A portion of the surface on the south side is favorably situated for the construction of a partial earth embankment, and the overflow could conveniently take place over a spillway of great length, built in an almost parallel direction with the contours of the valley on the northern bank of the river, the surplus water thus flowing in a channel with a gradual slope from its highest point to the river bed.

The water shed at that point is only 1½ sq. miles less than it is above Quaker Bridge. The storage would be practically the same; the dam would not be as handsome a structure, but it would cost less, and its total height would be 40 ft. less at the deepest point; the conditions as to the imperviousness of the side hills would, to all appearances, be superior. On the whole, if it were found advisable to build the originally proposed high dam at Quaker Bridge or in its vicinity, the merits of Cornell's site should be carefully considered before deciding on a final location.

In these two cases it is thought that, owing to the great height of the proposed structure, an all-masonry section should be mostly used; earth banks with a masonry core have been used successfully for lesser heights, and, if built to the height necessary in the cases now under consideration, might be found equally reliable; but, in view of the importance of the interests involved, it is believed that this is not the place for trying an experiment of such character and magnitude.

On the third site an earth embankment would be justified by practice, although an all-masonry section could, if desired, be adopted. At that point the width of the valley between flow-lines is 1,000 ft., and the extreme height of the crest above the river would be 100 ft.

The accompanying table, showing the principal features of the structure and the estimated cost in each case, is given for the better understanding of the following remarks:

Location.	Length of dam between flow lines., ft.	Capacity in gallons.	Estimated cost.— Dam proper.	Railroads and bridges and clearing.	Muscoot dams as previously estimated.
Quaker Bridge	1,402	34,000,000,000	$4,087,000	$1,075,000	300,000
Cornell's	1,736	30,000,000,000	3,650,000*	1,075,000	300,000
No. 2, Masonry	995	16,000,000,000	2,450,000	910,000	300,000
No. 2, Earth and masonry as recommended	995	16,000,000,000	1,750,000	910,000	300,000

*Approximated.

The Quaker Bridge Dam.

At this week's meeting of the Construction Committee of the new Croton Aqueduct Commission Chief Engineer A. FTELEY handed in his report upon the question of building the Quaker Bridge dam, in accordance with the instructions of the Commission to fully investigate this question.

Mr. FTELEY has greatly extended his investigations into the underlying strata by means of diamond-drill borings, and finds as a general result that the rock under the valley forms an excessive trough, the bottom of which lies 60 to 100 ft. below the bed of the river. This trough is filled with drift material generally composed of hard-pan, boulders and, at places, of peculiarly hardened sand. The river bed is mostly in this drift, sometimes over the deepest part of the rock depression, sometimes on the sides.

At a point showing remarkably favorable surface indications for a dam, he found that boring developed important layers of very soft material underlying the superincumbent rock at such a depth as to put out of the question the advisability of there building a very high dam. In making these investigations 176 holes were bored aggregating 14,005 feet in length.

Mr. FTELEY then generally considers the conditions of the Croton water shed and the facts which render the construction of a dam and the main stream a matter of necessity. He divides the water shed into two parts, one containing all the partial sheds corresponding to the various reservoirs built and building or proposed, and the other covering the territory between these reservoirs and the Croton Dam. While the latter area will vary with the smaller reservoirs built, the map of 1883 shows it to be about 115 sq. miles, or one-third of the whole Croton water shed. The only means of collecting the drainage from this lower territory, outside the small reservoirs, is by a new reservoir of large capacity on the main stream, the present Croton Lake not being of sufficient capacity for this purpose.

Not to build such a reservoir is to exclude from the source of supply a large portion of the main water shed, as is forcibly illustrated by the records of storage in dry seasons. For instance, in the middle of September of the present year, when the present storage basins, owing to the dry weather, had been drawn from to the extent of a number of feet below the flow line, a copious rain produced a heavy overflow of Croton Dam, amounting to over 600,000,-

000 galls. per day, while the upper reservoirs, during a comparatively limited territory, had shown but a small increase. It is true that subsequent rains filled all the reservoirs after a few days, but had dry weather prevailed instead the waste of water over Croton Dam would have been keenly felt.

An additional and very weighty argument in regard to the location of such a reservoir is that, although the present Croton Dam has rendered good service for half a century, it must be conceded that it is not built in such a manner as a structure should be, on which depends the very life of New York, and it is necessary that it be replaced by a more substantial one. It may be said also that, inasmuch as the important parts of the new aqueduc' system are now built in view of the construction of a high dam on the lower part of the river, the rest of the work should be made to conform to the existing features.

For the reasons given, and in view of the fact that the capacities of the Croton water shed must be as fully developed as circumstances will warrant, the necessity of a larger reservoir built below the present Croton Dam should be sufficiently demonstrated, but the site where the dam forming such a reservoir should be built has yet to be determined upon by the Commission.

When the present new aqueduct was commenced the plan adopted included a new reservoir a short distance above Quaker Bridge, with the intention of building as time would require a number of smaller reservoirs higher up the stream. This plan was consistent and endorsed by the highest authority. But for well known reasons an essential condition was omitted, that of commencing the great dam simultaneously with the new aqueduct, for the erection of the dam alone would probably occupy six years' time.

The situation is now radically different. Owing to the delay in coming to a decision regarding the location of the Quaker Bridge Dam, it was evident that additional storage for the new aqueduct could only be secured in time by the building of smaller dams, at East Branch, Bog Brook, Titicus River, and more recently the Carmel and Amawalk dams. These dams, being much smaller, consumed less time in construction. But they will only intercept the upper parts of the water shed, and the necessity for one on the lower part of the main stream remains as before explained. Mr. FTELEY, however, questions whether, for a long time at least, so large a storage capacity as would be furnished by the Quaker Bridge Dam is consistently needed, and whether it would not be more advisable to build, at a smaller cost, a structure of less magnitude, which would furnish ample storage for the next 20 years, and possibly to the whole extent to which the supply from the Croton water shed could be utilized. He suggests a favorable site for such a dam one mile below Croton Dam. At this point a water-level of the same height as proposed by the Quaker Bridge Dam would represent a storage of 16,000,000,000 galls., with 355.37 sq. miles of water shed above it, or 22.4 sq. miles less than at Quaker Bridge Dam and 1.8 sq. miles more than at Croton Dam.

Records of the gaugings taken for many years show that the amount of water collected in the stream at Croton Dam in the year extending from February, 1880, to February, 1881, if entirely retained for the use of the city, would have furnished a daily average of a little less than 250,000,000 galls. In order to ascertain the probable results of the system of storage, including the reservoir just mentioned at site No. 2, Mr. FTELEY caused computations to be made of the records of flow day by day during the extreme dry year 1880-1881, and applied them to the probable management of the storage, on the supposition that two such extreme dry years would follow one another, and that at the beginning of the first the reservoirs were in one case full, and in another case half full, the amount of water collected in and drawn from each reservoir being taken in proportion to its individual drainage area to the total area of the water shed. The diagrams indicate that, after taking into account the loss by evaporation, there would be left at the end of two years, just before the spring freshets, an amount of storage equivalent in the first case to 14,000,000,000 galls., in the second case to 8,000,000,000 galls. Owing to the well-known irregularity of the rainfall over various parts of the water shed and in successive years, it is obvious that the actual distribution of the flow for two subsequent dry years would vary from the results just presented, but they are sufficient to show that, in the instance given, covering two successive dry years, a daily supply of 250,000,000 galls. would have been maintained, with a surplus equivalent to an additional daily quantity of about 40,000,000 in one case and 20,000,000 galls. in the other.

New York now consumes 150,000,000 galls. of water daily, an increase of 35,000,000 galls. daily in the last two months. But, as Mr. FTELEY points out, the present condition is exceptional and due in great part to the inadequate supply of past years. He believes that without undue increase in water waste and the construction of all the proposed upper reservoirs, the water works here described would be ample for the next 20 years. Mr. FTELEY shows by a table that the accumulated interest on the sum saved at the present time by building the smaller dam on the lower main stream would be more than equal to its cost, and if at the end of 20 years it were found advisable to build the larger dam further down the valley, it could be erected without increased cost to the community, with the additional and obvious advantage of having two dams instead of one to control this immense body of water.

In conclusion, Mr. FTELEY does not recommend the building of a high dam either at Quaker Bridge or at Cornell's. He recommends the construction of a dam one mile below Croton Dam, built either entirely of masonry, or of earth embankment for a large part of its length; the latter plan is deemed sufficient and safe, and would take less time and less money. This smaller dam, as compared with the higher dam originally proposed, would drain 6% less water shed in area; but it can be built in 3 or 4 years, instead of 6; requires 1,600 acres less land; avoids the construction of a high and costly bridge at Wire Mill Road, over the present Croton Dam, and the construction of many other new roads and bridges, etc.

The proposed dam would have a spill-way extending 1,000 ft. along the side hill, with a stepped channel to the river below. The height of its crest would be 197 ft. above tide, with 3 ft. left for movable stop-planks. The top of the embankment would be 220 ft. elevation, and carry a road with a bridge over the spill-way. The total capacity of this reservoir would be 16,000 million gallons. Mr. FTELEY says that this location for a dam is not mentioned for the first time, as he understands it was seriously considered at the time of the construction of the present works. Chief Engineer ISAAC NEWTON, in his report of Feb. 21, 1883, also refers to the fact that a dam could be built immediately below the present Croton Dam, but did not recommend it, owing to the width of the valley and absence of rock. With the construction of the new Croton Dam, the total storage available, including the present reservoirs and those under construction, would be over 50 billion gallons, or more than 200 days' supply at 250,000,000 galls. daily.

The Aqueduct Commission accepted the report and ordered a public hearing on Oct. 25, before final action is taken.

The Mississippi River Commission.

The Mississippi River Commission held an important session in the Army Building, in this city beginning on Wednesday, Oct. 1, and continuing for four days. The object of the meeting was to allot the sum of $3,200,000, appropriated by the River and Harbor Bill for the improvement of the Mississippi below Cairo.

The members of the Commission are: Gen. C. B. COMSTOCK, Lieut.-Col. CHARLES R. SUTER and Major O. H. ERNST, of the Corps of Engineers, U. S. Army; Prof. H. L. WHITING, U. S. Coast and Geodetic Survey; Messrs. B. M. HARROD and HENRY FLAD, civil engineers, and Judge R. S. TAYLOR. The secretary is Capt. CHAS. F. POWELL. All of them were present. There were also in attendance the officers reporting to the Commission, namely, Captains D. C. KINGMAN and S. W. ROESSLER, of the Engineer Corps, and ARTHUR HIDER, C. E., representing C. McD. TOWNSEND, absent on account of sickness.

Besides the members and officers of the Commission there were present Senators GIBSON and WALTHALL and Representative CATCHINGS, as well as a large number of civil engineers and others representing interests affected by the proposed apportionment. The engineers were: Messrs. A. B. RICHARDSON, Chief Engineer of the State Board of Louisiana; WILLIAM STARLING, Chief Engineer of the Lower Mississippi Levee District, and T. G. DABNEY, Chief Engineer of the Upper Mississippi District.

The first two days were mainly consumed in hearing the members of Congress and the representatives of the levee and harbor interests. The second day's proceedings were signalized by the appearance of a strong delegation from the New York Chamber of Commerce, who particularly urged the propriety of a large allotment for levees. One of the features of the day's proceedings was an address by a colored man, ISAIAH MONTGOMERY, who has lately attracted a great deal of notice by a remarkable speech in the Mississippi Constitutional Convention, and who had previously distinguished himself by an address to the Senate Committee on Commerce last May. His remarks on the present occasion were so condensed, grammatical and thoughtful that many persons were incredulous as to their authorship. There is no doubt, however, that they were the production, solely and exclusively, of MONTGOMERY himself. He is a pure negro, but educated and intelligent, and is a considerable land owner. He is an ex-slave and was the property of JOSEPH E. DAVIS, the brother of JEFFERSON DAVIS.

There was the usual routine reading of orders and correspondence, after which the military engineers in charge of the several districts were heard, with their projects for channel improvement and bank revetment. On Saturday the doors were closed for deliberation, and allotments made, which, however, cannot be made public until they have been approved by the Secretary of War.

Legal Decisions of Interest to Engineers.

Care Required of a Railway Company in Transporting Passengers.—A railroad company is liable to a passenger for slight negligence, and is bound to furnish a reasonably safe and sufficient track, rolling stock and service, so far as can be provided by the utmost human skill, diligence and foresight, which is such skill, diligence and foresight as is exercised by a very cautious person; but it does not insure the safety of its passengers. (Furnish v. Missouri Pac. Ry. Co., Supreme Court of Missouri, 13 S. W. Rep., 1,044.)

Using City Dump Ground so as to Create a Nuisance.—A citizen of a city built a house near the city dump ground and brought suit against the city to recover damages for maintaining the dump ground in such a manner that it became a nuisance. He can recover, as a municipal corporation is liable for damages sustained by one of its citizens by allowing such a ground to become a nuisance. (City of Sherman v. Laugham, Supreme Court of Texas, 13 S. W. Rep., 1,042.)

Assault of Passenger by Sleeping-Car Porter.—A sleeping-car company is liable for injuries received by one of its passenger from an assault by the porter placed by the company in charge of one of its cars, and the passenger may recover from the company a fair pecuniary compensation for all injuries temporary or permanent, directly caused to him in his person, health and strength, including compensation for the pain and suffering, mental and physical, which has been or may thereafter be caused by such assault. (Campbell v. Pullman Palace Car Co., Circuit Court of the United States, Northern District of Iowa, 42 Fed. Rep., 484.)

THE HEGEMAN-OLIPHANT FILTER CO. recently filed articles of incorporation for the purpose of manufacturing filters and similar water-works supplies. The capital stock has been fixed at $500,000. The incorporators are CHAUNCEY M. DEPEW, M. OLIPHANT, M. M. MOORE, R. HAY and R. B. SEYMOUR. The offices will be in Jersey City and New York.

THE CONTINUATION of our abstract of U. S. Consul SHERMAN'S paper on the Municipal Engineering of Liverpool is unavoidably postponed until our next issue.

MT. ST. ELIAS, in Alaska, is shorn of 5,000 ft. of its alleged height of 19,500 ft. by Prof. RUSSELL, of the U. S. Geographical Survey. A survey has been made with the above result. But during this survey there was discovered what is claimed to be the largest glacier in the world, moving at the rate of 15 ft. per day. It was also found that there was a great range of mountains behind the St. Elias range, with several peaks averaging 12,000 ft. in height and covering more base area than does St. Elias. The fact is proven beyond doubt that Mt. St. Elias lies well within American territory in 60° 21' north latitude and 141° west longitude.

A REFRIGERATING PLANT, equal in capacity to the melting of 800 tons of ice daily, is now being built by the Fred. W. Wolf Co., of Chicago, for the George F. Swift Co., at the Stock Yards. Two 500

HP. Corliss engines will operate it, and the plant will be used for keeping the enormous storage rooms of the company at a proper temperature. The machines are of the Linde patent introduced in this country in 1883. This particular plant is claimed to be the largest in the world.

THE LIGNITE OF THE NORTHWEST TERRITORY, which underlies in immense deposits this timberless country, is to be utilized for heating and manufacturing purposes by a device now to be introduced by a company organized by Mr. WM. F. PHELPS, Secretary of the St. Paul Industrial Union. It is claimed that the difficulties inherent in its large percentage of contained moisture and lack of density are successfully overcome and that its advantages as a cheap heat producer can be fully utilized.

THE APPROPRIATION FOR PUBLIC LAND SURVEYS has been allotted by Secretary NOBLE for the year ending June 30, 1891. The amount allotted to Northwestern states is as follows:

States.	Amount.
North Dakota	$40,000
South Dakota	40,000
Idaho	20,000
Minnesota	10,000
Montana	75,000
Oregon	20,000
Washington	85,000
Wyoming	20,000

The reserve fund for contingencies is $27,000, an increase of $2,000 over last year. The sum of $40,000 is allotted for examination of surveys. The total thus appropriated is $425,000. Last year the appropriation was $185,000.

NICKEL-STEEL is not as new a compound for naval and military purposes as is generally supposed, though the plate lately tested at Annapolis was the first made at Le Creusot for public trial and the largest. Mr. HALL, of Sheffield, stated at the 1888 meeting of the Iron and Steel Institute that he had been experimenting with this alloy for some years, but only in 1887 obtained satisfactory results. He had obtained a tensile strength of 90 to 97 tons per sq. in., and an elongation of 8 to 7%, the percentage of nickel not stated. Mr. HALL also made very successful trials of a nickel-steel gun-barrel for small arms.

THE DESERT OF GOBI, in Central Asia, is to be explored by an expedition sent out by the Russian Government. The desert is 1,200 miles long by 500 to 700 miles wide and comprises the greater part of Mongolian and Chinese Turkestan.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Manistee & Grand Rapids.—A correspondent writes us that 7⅜ miles of track have been laid on this Michigan railway. The total projected length of the line is 110 miles, and of this 26¾ miles have been located and 14¼ miles have been graded. Tracklaying is now stopped on account of difficulties in securing right of way, but will be resumed, it is expected, in a few days. E. W. Muenscher, of Manistee, Mich., is chief engineer.

Wabash.—A meeting of the stockholders will be held Nov. 25 to consider the question of building a line from Montpelier, O., to Hammond, Ind., and of issuing $3,500,000 for that purpose.

Wheeling & Lake Erie.—Tracklaying will soon begin on the Martin's Ferry extension of this road.

Western Maryland.—President Hood is engaged in securing the right of way for the Potomac Valley R. R., projected to run from Williamsport, Md., to Cherry Run, W. Va., 14 miles.

Louisville, New Albany & Chicago.—This company has filed a mortgage for $12,800,000, given to the Central Trust Co., of New York City. The proceeds are to be used in paying outstanding loans against the company amounting to $10,000,000, and in improving the condition of the roadbed, equipment and buildings.

Philadelphia & Reading.—Construction on the line from Harrisburg to Bowmansdale, Pa., is making good progress. It is expected that all the masonry work on the piers crossing the Pennsylvania R. R. and the canal on the east bank of the river, and those crossing the Susquehanna River will be completed by Oct. 15. The superstructure over the railway and canal has been completed to Second St., in Harrisburg, and work is now in progress on the viaduct from that point to the east bank of the river. As soon as this is finished work will begin on the river spans.

Pennsylvania, Lehigh & Eastern.—At a recent meeting of the directors it was decided to begin construction at once. The road is projected to run from Port Jervis, N. Y., to Tomhickon, Pa. Joseph Pool, of New York City, is President.

Lancaster & Hamden.—It is stated that the money necessary to complete the lines from Hadley Junction to Wellston, O., has been secured, and that work will be rapidly pushed on construction. The route is through a fine coal region.

New York, Lake Erie & Western.—A press dispatch says:

The N. Y., L. E. & W. R. R is about to build a branch road from Crawford, on the New Jersey Central, through the Rahway river valley to Milltown, and thence south to Maplewood and South Orange, from which point it will parallel the Lackawanna, skirting the eastern slope of the Orange mountains, and connecting with the Watchung road at Main street station, Orange. The new line will then follow the Watchung to its terminus at Forest Hill, and run thence direct to Avondale. The scheme includes the completion of a double-track connection to the main line of the Erie at the west end of Bergen tunnel, and will secure to the Baltimore & Ohio and the Lehigh Valley roads a route for their New England freight, by which they may avoid the delay and expense of the New York transfer.

Rome, Watertown & Ogdensburg.—This company will build a branch from Woodard Station to South Bay, on Oneida Lake, a distance of 5½ miles, on condition that the people along the route grant the right of way and the necessary frontage on the lake.

Canadian Pacific.—It is rumored that this company has under consideration the construction of a branch from Newport, Vt., to South Hardwick, and thence to Marshfield, Vt.

Projects and Surveys.

Cleveland, Wooster & Muskingum Valley.—Chartered in Ohio to build a railway from Wooster to Lodi, O. Among the incorporators are Henry M. Keim, M. R. Dickey and W. F. Carr.

Fort Wayne, Terre Haute & Southwestern.—Incorporated in Illinois to build a railway from Fort Wayne to Terre Haute, Ind., and thence across the State of Illinois.

Chambersburg & Gettysburg.—Chartered in Pennsylvania to build a railway from the Mount Alta R. R. to the Wolf Hill ore mines.

Barre.—Surveys have been completed for a railway from East Barre to quarries.

Toronto, Hamilton & Buffalo.—There is a prospect that work will soon commence on this Canadian road. E. B. Wingate, Hamilton, Ont., Chief Engineer.

Bridgeton & Carbon.—A company has been chartered to build a railway from Bridgeton to Carbon, Ind., 10 miles. J. J. Safely, of Brazil, Ind., is interested.

Niagara Falls & Lewiston.—Chartered in New York to build a railway from Lewiston to Niagara Falls, N. Y., a distance of 7 miles. Frank M. Brinker, Buffalo, N. Y., William Jones, Pittsburg.

SOUTHERN.—Existing Roads.

Carolina, Knoxville & Western.—The contract for completing this road from Augusta, Ga., to Knoxville, Tenn., has been let to a construction company. It is stated that work will begin in about two months, and the road pushed to completion as rapidly as possible. Jas. U. Jackson, of Augusta, is President of the construction company.

Louisville & Nashville.—The grading has been nearly completed on the line from Gurnee to Bessemer, Ala., and tracklaying is now in progress.

Chattanooga Southern.—Work is making good progress on the division between Chattanooga, Tenn., and Gadsden, Ala. It is stated that the company will purchase the franchises of the Gadsden, Shelby & Montgomery R. R., projected from Gadsden to Montgomery, Ala., and will build at once to Montgomery.

Newborn & Social Circle.—Grading is reported in rapid progress on the proposed railway from Newborn to Social Circle, Ga.

Huntington & Big Sandy.—The contract for grading this road from Huntington to Ceredo, W. Va., is reported let, the work to be completed before Christmas.

East Tennessee, Virginia & Georgia.—The surveys for the branch of the Memphis & Charleston R. R. from Tracy to Owens, Tenn., has been completed. The distance is 14 miles. From Dunlap to Pikeville construction is in progress, 6 miles of track being already laid.

Roanoke & Salem Dummy.—This road is now completed from Roanoke, Va., to Mason's Creek. Construction is in progress on the bridge across the creek, and as soon as this is completed track will be laid on the remainder of the line. The total length of the road will be 7½ miles.

Norfolk & Western.—It is rumored that this company will build a branch from Berryville to Round Hill, Va., connecting the Shenandoah Valley R. R. with the Richmond & Danville R. R.

Birmingham & Atlantic.—This recently organized company has purchased the Talladega & Coosa Valley R. R., running from Pell City to Talladega, Ala., 25 miles.

Charleston, Sumter & Northern.—About 4 miles of track from Bennettsville, S. C., south have been laid.

Richmond & Tidewater Coal & R. R. Co.—A correspondent writes as follows:

This road is projected to run from a point on the Richmond & Danville R. R., near Coalfield Station, to Tomahawk Church, Va., a distance of 5 miles, for the present. It will ultimately be extended to Bermuda Hundred, a distance of 30 miles. The work is about average. The principal business will be in coal and lumber. S. P. Clay & Bro., of Richmond, Va., have the contract, the work to be completed by Dec. 1. F. G. Gabany, of Midlothian, Va., is Chief Engineer.

Genesis & Obed River.—Capt. Lina Beecher, of Crossville, Tenn., President, writes as follows:

The surveys have been completed and construction is now in progress on the Crossville Branch of this road, which is projected to run from Johnson's Stand to Crossville, a distance of 18½ miles. The route is along the "divide" of the Cumberland plateau and passes through rich timber and mineral lands. All of the right of way has been received and Cumberland Co. has released the company from taxes for 20 years. G. W. Youngs, of Crossville, has the contract. About 40 men and 10 teams are now at work, and 3 miles of the grading are completed. N. C. Massie is Chief Engineer, with headquarters at Crossville.

Montgomery, Tuscaloosa & Memphis.—E. M. Craig, Chief Engineer, of Montgomery, Ala., writes as follows:

The Montgomery, Tuscaloosa & Memphis R. R. is projected to run from Montgomery, Ala., via Prattville, Maplesville, Cartersville and Tuscaloosa, Ala., to Artesia Miss., a distance of about 257 miles. On the section from Montgomery to Tuscaloosa, 107 miles, 50 miles of the grading have been completed, and work on the remaining 57 miles is well under way, 200 teams and a large force of men now being at work. The earthwork averages about 30,000 cu. yds. per mile; maximum grade 1.25%, and maximum curve 6°. There are bridges across the Alabama, Cahaba and Black Warrior rivers, 800 ft., 200 ft., and 525 ft. respectively. The surveys for the section from Tuscaloosa to Artesia will be commenced this fall. The principal business of the road will be the through western traffic and the transportation of cotton, lumber, naval stores and minerals. Tracklaying is expected to commence about Nov. 1. The work is in charge of the Chief Engineer.

Louisville Southern.—The Richmond, Nicholasville, Irvine & Beattyville R. R. has been opened for traffic to Richmond, Ky. Tracklaying is now in progress between Richmond and Beattyville, Ky.

Middle & East Tennessee.—The grading is nearly completed on the line from the Chesapeake & Nashville R. R. to Hartsville, Tenn., and tracklaying will soon begin.

Escambia.—A press dispatch says:

A new railway, to be known as the Escambia Ry., will soon be put in operation from Sullivan Station, on the Mobile & Montgomery Division of the Louisville & Nashville R. R., to Monroeville, Ala. This road will be 40 miles in length, and 17 miles are already completed. The remainder will be pushed through at once. At a meeting held recently at Sullivan the following officers were elected: M. H. Sullivan, President; J. W. Black, Vice-President; W. A. S. Wheeler, General Manager; S. R. Sandford, Superintendent; J. J. Sullivan, Secretary and Treasurer. The surveys have been made, and the officers say that the road will be put through to Monroeville at once.

Tennessee Central.—A press dispatch says.

J. A. Glasgow, Secretary of the Tennessee Central R. R., has written to the committee appointed by the citizens of Milan and Trenton that the road will surely be pushed through this winter. The road extends from Trenton, Tenn., to Milan, Tenn., thence to Huntsville, Ala.

Projects and Surveys.

Montgomery, Pensacola & Mobile.—Chartered in Alabama to build a railway from Luverne, Ala., southwest through Alabama to a connection with Mobile, Ala., and Pensacola, Fla. The enterprise is supposed to be backed by the Plant Railway System. The officers are: John C. Woolfolk, President; E. B. Joseph, Vice-President; W. C. Black, Secretary and Treasurer.

Bluefield & Princeton.—Incorporated in West Virginia to build a railway from Bluefield, W. Va., to Princeton, W. Va. Among the incorporators are: David E. Johnston and Isaiah Bee. The principal offices will be at Bluefield.

Thomasville & Southern.—An application will be made for a charter to build a railway from Thomasville, Ga., south to a point on the Florida State line, where it will connect with a railway running north from Tallahassee, Fla. Among the incorporators are: R. L. Bennett, J. S. Montgomery and W. E. Davies.

Blue Ridge Construction Co.—Chartered in Georgia with a capital stock of $500,000 to build railways. The incorporators are: John C. Short, New York City; Wm. Bailey, St. Louis, Mo.; Jno. W. Jackson and Wm. E Jackson, of Augusta, Ga.

Spartanburg, Glendale & Clifton.—A charter will be applied for for the construction of a railway about 10 miles long in South Carolina.

Ohatchie Valley.—This company has been chartered in Alabama to build a railway from Laney to Piedmont, Ala. The officers are: John C. Laney, President; Felix E. Jackson, Secretary, and Jas. E. Lane, Treasurer.

Blacksburg & New River.—This company has completed its organization by the election of the following officers: J. E. Christian, Roanoke, Va., President; W. E. Hubbert, Blacksburg, Va., Vice-President, and W. N. Graham, Secretary. The preliminary survey will be made soon.

Cumberland Gap & Mississippi Valley.—At a recent meeting of the directors it was voted to commence the surveys for this road at once. The road is to run from Columbus, Ky., to Cumberland Gap, Tenn.

NORTHWEST.—Existing Roads.

Black Hills & Fort Pierre.—A correspondent writes as follows:

This railway was originally projected as a lumber road by the owners of the Homestake mines. It runs from

Lead City to Piedmont, S. Dak., a distance of 38 miles. Of this 15 miles have been completed this year. The road is 3 ft. gauge, and runs through a mountainous region; maximum grade 4%, and maximum curve 36°. The principal business will be in supplies for the mines along the route and the general traffic to Lead City. I. J. Greer is General Manager, and Richard Blackstone is Chief Engineer and Superintendent.

Duluth & Winnepeg.—This company asks the citizens of Duluth, Minn., to subscribe for $500,000 of stock in aid of the road.

Chicago, Rock Island & Pacific.—The grading on the line from Lincoln to Omaha, Neb., is nearly completed, and track laying will commence soon.

Milwaukee, Menominee Falls & Western.—An extension of this road from Sussex to North Lake, Wis., is projected and the preliminary surveys have already been made. The extension is 8 miles long and passes through a fine farming country and into the Waukesha County lake region. There will be one heavy cut and one pile bridge; maximum curve 4°. W. Powrie, Templeton, Wis., Chief Engineer.

Minneapolis, St. Paul & Sault Ste. Marie.—Geo. Parker, a contractor, is advertising for 500 men and teams to work on an extension of this road from Hankinson, N. Dak., northwest. The line as surveyed runs from Hankinson northwest through Ransom, La Moure, Barnes and Stutsman counties and follows the Jim River Valley north.

Projects and Surveys.

Little Falls & Southern.—Chartered in Minnesota to build a railway from Little Falls south to the State line. Among the incorporators are: W. H. S. Wright, Chas. S. Bunker and W. D. Cornish, all of St. Paul, Minn.

Red Lake Falls & Western.—Surveys will commence at once on the line from Red Lake Falls, Minn., to St. Thomas, N. Dak. As soon as this section is completed the engineers will locate the line from Red Lake Falls to Duluth, Minn.

SOUTHWEST. Existing Roads.

Lampasas, Burnet & Southwestern.—The contract for constructing this road from Llano to Waco, Tex., is reported let.

Projects and Surveys.

San Angelo, Abilene, Henrietta & Red River.—This is the name of the company which proposes to build a railway from San Angelo to Abilene, Tex. M. Robertson, of San Angelo, Tex., is interested.

Taylor, Georgetown & Western.—At a meeting of the citizens recently held it was decided to build a railway from Taylor, Tex., to a connection with the Austin & Northwestern R. R. Application will be made for a charter at once. The officers are: A. V. Doak, Taylor, President, and G. W. Glasscock, Georgetown, Tex., Vice-President.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—About 25 miles of the extension of this road from Fort Assinaboine, Mont., west, have been completed and construction is making satisfactory progress. The construction force is to be increased and it is expected to have the line completed to the summit of the mountains before cold weather commences. The grading is well advanced on the entire section. Considerable difficulty is found in obtaining a satisfactory route through the Cascade Mountains. Several lines have been surveyed, but they all necessitate the construction of tunnels, varying from one to three miles in length.——Work is satisfactorily progressing on the Fairhaven & Southern R. R. On the line from Fairhaven, Wash., south, grading and tracklaying are being pushed. From Fairhaven, north, 10 miles of track have been laid, and it is expected to have the line completed to Blaine, Wash., by Nov, 1.——Shepard, Siems & Co., the contractors, have advertised to sublet contracts for scraper work on the line in Montana. The work will continue for two or more years. Address National German Bank Building, St. Paul. Minn.

Union Pacific.—Chief Engineer V. G. Bogue is quoted as saying:

"The Union Pacific has made surveys into both Northern and Southern California, but so far as I know extensions into the State have not been decided upon. If anything has been done since the surveys were made I am ignorant of it. The surveys into Northern California were completed some two years ago, but I prefer not to speak in detail about them. The surveys into the southern part of the State were made not long ago. Three surveys were run, all from Pioche, Nev., south. One runs to Homer and another to Ludlow, points on the Atlantic & Pacific road. The third survey runs to the Southern Pacific road. All of these surveys were made to furnish to the directors of the company information about the State. Further than that I don't care to speak at the present time. The company is building about 555 miles of new roads. One piece is an extension from Milford to Pioche, a distance of 145 miles. It will be completed by Feb. 1, 1891. Another new road is the line from Portland to Seattle. We have 2,000 or 3,000 men at work on it now, and want 2,000 more very badly. We are also building a branch of 20 miles in Oregon, between La Grande and Elgin; also an extension in Wyoming to our Cheyenne & Northern road for a distance of 30 miles. It will go as far as Fisher, where connection will be made with the Chicago & Northwestern. A short extension in Idaho is also being made, and one in New Mexico, through the Maxwell land grant, for a distance of 15 miles, starting from Trinidad."

Chicago, Rock Island & Pacific.—General Manager E. St. John is reported as saying:

"The Rock Island is now contemplating an extension west of Colorado Sorings, and if it should turn out to be true that the Atchison has bought our western connections into Ogden, which you probably know are the Colorado Midland and the Rio Grande Western, that of itself would not be a reason for us to make an extension to Ogden. We shall make traffic arrangements sufficient to answer our purposes. Refusal to give us favorable arrangement would compel us to protect ourselves in some way. The question of an extension depends upon whether or not we get favorable offensive or defensive traffic agreements. Such is the case with all roads terminating in Eastern Colorado. Thirty days' time might be sufficient to induce the company to extend, if its western connections began to be unreasonable."

Astoria & South Coast.—Work is to be resumed at once upon the construction of this road. The contracts for construction have been let to two Chinese firms, and work is to commence at once. Fourteen miles of rails are due from Pennsylvania.

Southern Pacific.—About 15 miles of track have been laid on the line from Merced to Oakdale, Cal., 40 miles. Grading is completed from Merced north to the Merced River, and is in progress between the present end of track south to the same point. It is expected to have the entire line completed by Dec. 1.

Pajaro Valley.—This company will extend its line to Salinas, Cal., and possibly to Cerralitos, Cal., next season.

Little Book Cliff.—W. T. Carpenter, of Grand Junction, Colo., President, writes as follows:

This road is projected to run from Grand Junction to Book Cliff, Colo., a distance of 11 miles. The grading has been finished and 5 miles of track laid. Tracklaying is in progress on the remaining 6 miles. The route is through a rough country; maximum grade 5%, and maximum curve 20°. Its principal business will be in the summer tourist travel and stone and coal. The company will offer $50,000 of first mortgage 6% bonds for sale Oct. 15. E. B. Sawyer, of Montrose, Colo., is chief engineer.

Port Angeles Central.—Jas. Wickersham, of Tacoma, Wash., President, writes as follows:

This road is projected to run from Port Angeles, Wash., south toward the Elwha River, a distance of 85 miles. Three and one-half miles have already been graded and 7 miles surveyed. Work is now stopped on account of difficulty in crossing the Port Angeles town site reservation. An application will be made to Congress for right-of way. Work, it is expected, will be resumed in the spring of 1891.

Projects and Surveys.

Denver, Lakewood & Golden.—E. L. Birthoud, of Golden, Colo., Chief Engineer, writes as follows:

The preliminary surveys have been completed for this road, which is projected to run from Denver to Golden, Colo., 12½ miles, and 7½ miles of the line are located. The work will be generally light; maximum grade 1.9% and maximum curve 8°. The principal business will be in general merchandize, stores, coal and minerals. Contracts will be let soon and the road completed this season.

Santa Monica Surf.—Projected to run from Santa Monica to Ballona Harbor, Cal. Thos. J. Rush and J. A. Stanwood, both of Los Angeles, Cal.

Jacksonville & Medford.—Final arrangements have been completed for commencing construction of this Oregon railway. The rails have been ordered and work will begin soon.

CITY TRANSIT.

Electric Railways.—New plants or extensions are proposed at Lynn, Mass., Albany and Batavia, N. Y.; at the latter place Mayor Burt is interested; Wilkesbarre, Pa.; Baltimore, Md., address Baltimore Sugar Refining Co.; Wytheville, Va.; Washington, Ga., address Excelsior Mfg. Co.; Duquoin, Ill.; Clarksville, Tenn.; Bay City, Mich.; Sturgis, So. Dak.; Denver, Col., by East Colfax Electric Ry.

Andover, Mass.—The petition of the Merrimac Valley Horse R. R. for right to construct an electric railway between Andover and Lawrence has been granted.

Worcester, Mass.—A 13 mile standard guage electric railway will probably be built from this city to Spencer and Leicester. A company with $250,000 capital has been formed to carry out the work; Samuel Winslow, of this city, can give further information.

Long Island City, N. Y.—The Long Island City & Newton R. R. has received permission to exchange horses for electricity as a motive power.

Watertown, N. Y.—C. W. Hatch, of Boston, and a number of Watertown capitalists have formed a company and made contracts for the construction of an electric street railway in this city. The material is now on the way here and the road will be in use this winter. Four miles of road will be built to begin with.

Jamestown, N. Y.—The Street Railway Co. has received permission to use electricity on all its lines in place of horse power.

Buffalo, N. Y.—The West Side Street Ry. has petitioned for the right to build and operate an electric railway on a large number of streets.

Schenectady, N. Y.—The Edison General Electric Co. has purchased the Schenectady Street Ry. The company will extend the system and replace the horse cars with Edison's new electric motors.

Paterson, N. J.—The Board of Aldermen has granted permission to the Horse Ry. Co. to use electric motors.

Knoxville, Tenn.—The Elmwood Park Ry has changed its name to the Knoxville Rapid Transit Co., and will construct a number of new lines.

Bristol, Tenn.—The Bristol Street Railway Co. will construct 3 miles of new road to be operated by electricity, and desires bids.

Dayton, Tenn.—The Tennessee Industrial Land Co. has authorized W. Englewood to receive bids for the construction of an electric railway on its property.

Chattanooga, Tenn.—The Electric Railroad Co. has secured permission and will soon commence to erect the electric plant for its lines.

Terre Haute, Ind.—It has been decided to run the street lines by electricity.

Alton, Ill.—The street railways now in this city have all been acquired by a new company, the Consolidated Electric Ry., which proposes to extend existing lines and operate the whole system by electricity.

Bay City, Mich.—The Bay City St. Ry. has been sold to the Union Street Ry. for $100,000, which will introduce the electric system on all its lines.

Detroit, Mich.—The *Free Press* states that the Detroit City Ry. intends to extend some of its lines and introduce electricity before the beginning of winter.

St. Louis, Mo.—A bill has been introduced in the House of Delegates authorizing L. J. Howard, G. B. Thomson and others to construct a street railway operated by steam, horses, electricity or cable.

Topeka, Kan.—The Topeka City Ry., has received permission from the City Council to operate its lines by electricity.

Beaumont, Tex.—The Beaumont Ice, Light & Refrigerating Co., proposes building a 4-mile electric railway.

Denver, Colo.—The East Colfax Electric Co., has filed articles of incorporation for the purpose of building an electric railway, costing about $100,000, to the suburbs of Montclair, and East Colfax.

Fargo, N. D.—It is reported that surveys are being made for an electric line to Moorhead, Minn.

Los Angeles, Cal.—B. O. Carr has received a franchise for building and operating an electric railway.

Horse Railway.—***Glastonbury, Conn.***—The lines of the railway in this town have been surveyed and construction will soon begin. The Hartford & Wethersfield R. R. control the work.

Dummy Railways are projected at Bessemer, Ala., by W. Berney, R. Jemison and others, and between Ringgold and Catoosa, Ga.

Opelika, Ala.—The Opelika & Auburn Street Railway & Dummy Line Co., has received its franchise from the City Council. Surveys are being made for the line and construction will probably begin as soon as the road is staked out.

Ypsilanti, Mich.—Donovan, Morgan & Co., St. Louis, Mo., have a contract for several miles of line on which the motive power will be supplied by naphtha engines.

Medford, Ore.—A contract for a dummy line to Jacksonville, has been signed by J. Numan and S. H Hull on behalf of the two towns.

Elevated Railways.—***Boston, Mass.***—The estimated cost of the elevated lines proposed in this city is $400,000 per mile. The engineers have endeavored to combine all the good points of the structures in Brooklyn, New York and Chicago, and at the same time reduce the cost of the work by $100,000 per mile below that of previous lines.

Cable Railway.—***Baltimore, Md.***—It is reported that the Baltimore Traction Co. will extend its line to Canton.

New Companies.—Pittsfield, Mass.—Electric Street Ry., capital stock, $400,000; directors, J. Tucker, W. Cutting, J. L. Bacon and others. Suffolk Street Ry., Suffolk, Va., Lee Britt, Secretary. East St. Louis & Venice (Ill.) Street Ry., incorporators, A. Carr, B. Sikking and H. Robinson. Montclair Railroad Co., Denver, Colo.; capital stock, $100,000; incorporators, H. Bohm, C. A. Raymond, M. A. Smith and others. Portland & Fairview R. R. Portland, Ore.; capital stock, $50,000; incorporators, O. V. Monroe, A. W. Lambert, J. D. Hart.

HIGHWAYS.

Tampa, Fla.—The Bay Shore Road Co., has been incorporated with a capital stock of $40,000 to build a macadamized road some 12 miles in length.

Livingstone, Mont.—It is reported that work will begin soon on the new roads to the Yellowstone Park.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Fall River, Mass.***—The plans of the City Engineer for a bridge across the tracks of the Old Colony R. R. at South Park have been approved, and the bridge will be built. It will cost $8,000.

Hancock, Md.—A bridge across the Potomac River at this point will probably be built.

Howard Co., Md.—It is proposed to build a bridge across the Patapsco River at Orange Grove.

Charlotte, N. C.—A bridge will be built across the tracks of the Charlotte, Columbia & Augusta R. R.

Augusta, Ga.—Bids are asked for building a bridge across the Savannah River. The bridge is to be of steel and must be completed by April, 1891. Address Grant Wilkins, Engineer, 9½ Peachtree St., Atlanta, Ga.——A new bridge will be built across Beaver Dam Creek.

Dublin Co., Ga.—A steel bridge will be built across the Oconee River to cost $15,000.

Pineville, Ky.—The West Virginia, Pineville & Tennessee R. R. will build a bridge at this point to cost $40,000. W. W. Duffield, Chief Engineer, Pineville.

St. Louis, Mo.—An ordinance has been passed authorizing the construction of a stone and cement foot bridge across River des Perre.

Seattle, Wash.—Bids for constructing a 1,320-ft. trestle across Dawamish swamp are asked for. W. R. Forrest, County Auditor.

Tunnels.—***Duluth, Minn.***—There is talk of constructing a tunnel under the ship canal at this point.

Canals.—A conditional decree for the sale of the Chesapeake & Ohio Canal has been issued by Judge Alvey. The bondholders of 1844 have been granted permission to pay off the bonds of 1878 and repair the canal, provided the work be completed by May 1, 1891.

WATER-WORKS.

NEW ENGLAND.

Bethel, Me.—The Works of the Bethel Water Co. are nearly completed.

Manchester, N. H.—A report on a new high service supply has just been submitted to the Water Commissioners by Percy M. Blake, Hyde Park, Mass. The report considers eight different plans, and gives the estimated cost of each. Cost considered, the best plan is to pump the high service supply through a 16-in. main to a new reservoir, the whole cost being estimated at $85,156. If it should seem best to combine with the high service a provision to supply part of the present low service, the same reservoir recommended in the other plan could be used and additional pumps be placed at the old station. This plan would cost $145,000 or $160,000, according to the new pumping capacity and the size of the force main. The complete report was published in the Manchester *Union* for Oct. 7.

Hardwick, Vt.—Ira A. Shattuck has sent the following:

Aiken & Bridgman will build gravity works at an estimated cost of $10,000. A dam will be built across a brook thus forming a reservoir 250 ft. above the village. The dam will be built this fall. Population, 500.

Boston, Mass.—A $250,000 30-year water loan has been voted, the money to be used in extending the mains.

Chicopee, Mass.—There is talk of the city purchasing the works of the Chicopee Water Co.

North Brookfield, Mass.—An act of the Legislature in 1889 gave the town the right to build works. It was reported that the citizens would vote upon the question Oct. 10.

Meriden, Conn.—The Water Committee has reported in favor of obtaining an additional supply from John Hall Brook. The plan includes a dam 33 ft. high to the flow line which would impound 186 000,000 galls. From this reservoir 5,000,000-gall. pumps would force water through 20,500 ft. of 20-in. pipe to the city, and through a 20-in. branch, 1,700 ft. long, to a new distributing reservoir. For the latter it is proposed to purchase a reservoir already built, and raise its dam 6 ft., giving the water surface an elevation of 279 ft. above the railway tracks in Meriden. The estimated cost of the project is $200,000, but if the new reservoir should be omitted from the plan, and the water be pumped to the old reservoir instead, the cost would be but $131,000. The complete report, which considers three other plans, was given in the Meriden *Republican* for Oct. 7.

MIDDLE.

Albany, N. Y.—The driven well system has proved a failure, so far as quantity is concerned. The daily yield is but about 4,000,000 galls., while the contract called for 15,000,000 galls. The water secured is of a good quality.

Buffalo, N. Y.—Permission to lay water mains in 18 streets and avenues has been granted to the Water Department.

Fultonville, N. Y.—The Mohawk Valley Lumber Co. will erect a large water tank for fire protection. It will be placed on a 60-ft. trestle.

Glens Falls, N. Y.—The Galvin Valve & Hydrant Co., of Detroit, Mich., has been awarded the contract for furnishing 28 double-nozzle fire hydrants, with 4-in. connection and 18 valves.

New York, N. Y.—A. Fteley, Engineer of the new Aqueduct Commision, has made a report to the Construction Committee on the much discussed Quaker Bridge dam. The report is reviewed at length in another column.

West Troy, N. Y.—Bids for putting in the new water supply were received as follows on Oct. 6:

Charles Brown, of Mohawk, N.Y., $3,730; W. H. Barnes, of Troy, N. Y., $4,990.

Cranford, N. J.—A petition for permission to supply the town with water has been made by Wolcott C. Foster, of 52 Broadway, New York City.

Allegheny, Pa.—The lowest bid for the construction of all the improvements, as advertised in these columns, was made by the Municipal Water Supply Co., the amount being $1,720,000.

Corry, Pa.—A suit has been brought against the Corry Water-Works Co. by its stockholders, asking for the appointment of a receiver and an injunction to prevent the sale of the works by the company. The plaintiffs claim that the works really cost but $60,000, but that bonds to the amount of $100,000 have been issued and paid to the contractors. The company claims that the works cost $100,000.

SOUTHERN.

Tarborough, N. C.—It is reported that I. N. Cox, of Washington, D. C., has offered to purchase and extend the works built by the town in 1889.

Greenville, S. C.—The following is from J. W. Ledoux, Engineer:

Construction will be immediately commenced upon a gravity system of works. Water will be taken from a mountain stream at a point about 7 miles from and 200 ft. above the town. A masonry dam 45 ft. high will be built. The supply main will be 12 ins. in diameter, and there will be 10 miles of distributing pipe. The American Pipe Manufacturing Co., of Philadelphia, are the contractors.

Atlanta, Ga.—Oct. 14 the citizens will vote on the issuance of $250,000 4½ water bonds for improvements to the works. The proposed new works will pump water from the Chattahoochee River. A contract for cast-iron pipe has been awarded to the Howard-Harrison Iron Co., of Bessemer, Ala., at $22.24 per ton, and $2.50 per hundred for specials. R. D. Wood & Co. have the contract for valves, and all the recent bids for filters were rejected, since the filters will not be needed for more than a year. The bids for pumping engines were under consideration at the time of the latest reports.

De Land, Fla.—Contracts have been let for three 500-ft. wells for a water supply.

Montgomery, Ala.—The Capital City Water Co., wants $750,000 for its works, while the city offers but $250,000. If the city buys the works the price will have to be determined by arbitration.

Opelika, Ala.—The Opelika Water-Works Co. has been incorporated by B. K. Collier and N. L. Wright of Opelika, and others, with a capital stock of $100,000, most of which will be taken by Chattanooga and Philadelphia parties. The city has already granted a franchise.

Mount Sterling, Ky.—It is reported that the Mt. Sterling Water-Works Co., will build works at an estimated cost of $85,000.

NORTH CENTRAL.

Zanesville, O.—We are indebted to R. M. Saup for the following:

The Water Commissioners have recommended important extensions to the works, estimated to cost $175,000. The question of bonding the city for this purpose and amount will be voted upon in November. The proposed improvements include the sinking of wells, a new 6,000,000-gall. pump, a 30 × 100-ft. stand-pipe and some 30 and 12-in. mains.

Rushville, Ind.—The bids for the franchise, to be received until Nov. 3, must be based upon the following general provisions:

Water must be secured from wells and pumped directly to the mains by two pumps having an aggregate capacity of 3,000,000 galls. There must be not less than 8 miles of mains within the city limits, none of which shall be under 6 ins. in diameter. There will be 100 double-nozzled fire hydrants. The city reserves the right to purchase at the end of 10 years, and at any time thereafter upon giving 6 months' notice. W. T. Jackson is Mayor.

Madison, Ill.—A site for the water-works has been selected by T. C. Johnson and M. E. Flad.

NORTHWESTERN.

Abilene, Kan.—The representatives of the first mortgage bondholders of the Abilene Water & Electric Light Co. have secured the appointment of George A. Rogers as receiver. The bondholders propose to expend $55,000 in improvements, including a new supply from a spring four miles distant. These improvements, it is stated, may be prevented by legal proceedings brought by the city.

Topeka, Kan.—Two resolutions regarding water-works have been introduced in the City Council, one looking towards the construction of new water-works by the city the other instructing the city attorney to declare the water company's franchise forfeited.

Hebron, Neb.—Plans and specifications for a $25,000 system of water-works are being prepared by A. A. Richardson, of Lincoln.

Wayne, Neb.—The following is from Frank Fuller, Mayor:

Contracts will be let about Nov. 1 for works, bonds for which have been voted. Water will be pumped from wells or a creek to a stand-pipe. Estimated cost, $18,000. Population, 1,500.

Sturgis, S. Dak.—A franchise has been granted allowing a company to construct water-works, an electric lighting system and a street railway to Fort Mead, the whole to cost $200,000, and to be completed not later than July 1, 1890.

Cheyenne, Wyo.—Improvements estimated to cost $60,000 are recommended in a report by Elwood Mead, State Engineer. The improvements consist of a dam and additional galleries at the source of supply, and also at Nineteenth St., a stand-pipe and additional mains. The first-named dam will be carried below the bed of the stream to cut off the underground waste.

SOUTHWESTERN

St. Louis, Mo.—The contract for the pumping engine has been awarded to the lowest bidder, Henry R. Worthington, for $299,500.

Eddy, Tex.—Water-works have been projected.

Fort Worth, Tex.—The experimental artesian well has been tested at a depth of 1,150 ft., and yields at the rate of 320,000 daily. It will be sunk deeper.

Galveston, Tex.—Only one bid was received for the sinking of the well to increase the water supply, and that was unsatisfactory.

Luling, Tex.—The laying of the mains was begun Oct. 4, and the stand pipe is already under way.

San Antonio, Tex.—The proposition to issue $2,000,000 of bonds for the purchase of the San Antonio Water-Works Co.'s plant was defeated by a vote of the citizens, but the total vote cast was only 1,800.

South Denver, Col.—It is stated that 25 miles of extensions to the mains are needed, but that the money to pay for the same cannot be raised earlier than May 1, 1891.

PACIFIC.

North Yakima, Wash.—The water-works are nearly ready to be put in operation.

Olympia, Wash.—The following is from W. W. Curtis, St. Paul, Minn., Engineer for the reconstruction of the works:

The Olympia Water-Works Co. will take its new supply from Morley Creek, through a wood flume 1,000 ft. long. There will be a new 1,750,000-gall. reservoir and two Worthington compound pumps, 3 miles of 12 to 4-in. cast iron and 5 miles of 8 to 4-in. wood pipe will be laid. Mathews hydrants and Eddy valves will be used. W. F. Newell is Secretary of the company.

East Portland, Ore.—The East Side Water Co. has contracted for a 3,000,000-gall. Worthington pumping engine and two 100-HP. boilers, the whole to cost $11,610.

CANADA.

Montreal, P. Q.—Proposals will be received until Oct. 14 for a boiler of the locomotive type for the high-level pumping station at McTavish St.

Markham, Ont.—The following is from M. White:

The town proposes to let contracts within a month for works estimated to cost $12,000. The supply will be from springs on the hillside, from which water will be conveyed to a 45,000 gall. basin. From the basin the water will be pumped through a 6-in. main to an elevated tank 60 ft. in height. Population, 1,200. John Galt, East Toronto, is Engineer.

IRRIGATION.

Kansas.—The Irrigation Land Co., of Topeka and Las Animas, Col., has been incorporated with a capital stock of $250,000. Among the directors are John R. Mulvane and J. R. Burton.

Arlington, Col.—The Arlington Canal, Reservoir & Water Co. has been incorporated with a capital stock of $50,000.——The Adobe Creek, Canal & Reservoir Co. has been incorporated with a capital stock of $25,000. J. S. Booker and W. W. Patton are interested in both companies.

Boise City, Ida.—W. C. Bradbury & Co., of Denver, are constructing a large irrigating ditch near here, which has much heavy work, including a large amount of rock.

SEWERAGE AND MUNICIPAL.

Sewers have been ordered in the following cities: Buffalo, N. Y., 10, 12 and 15-in. pipe; Troy, N. Y., 27 × 40, and 37 × 56-in. brick; Newark, N. J.; Hartford, Conn.; Pittsburg, Pa.; Cincinnati and Columbus, O.; St. Paul, Minn.; Albina, Ore.

Quincy, Mass.—The Committee on Sewerage has reported in favor of issuing bonds to the amount of $100,000 for constructing a complete sewerage system.

Buffalo, N. Y.—Assessment rolls for brick and pipe sewers, costing $22,370, have been filed.

Rochester, N. Y.—A number of pipe sewers, costing in all about $3,400, are proposed.

Orange, N. J.—The Citizens' Committee has reported favorably on the sewerage system proposed by Carrol Ph. Bassett.

Atlanta, Ga.—An $80,000 sewer has been ordered by the Common Council.

Macon, Ga.—It is expected that $200,000 of bonds for new sewers will soon be issued.

Henderson, Ky.—The expenditure of $50,000 for sewers in 1891 is under consideration.

Knoxville, Tenn.—Nier, Hartford & Mitchell, of Chattanooga, have been employed to make a report on a sewerage system.

Anderson, Ind.—A topographical survey of the city, looking toward a sewerage system, has just been completed. Henry Rawle is City Engineer.

Aurora, Ill.—Plans have been made by Chester B. Davis, of Chicago, and somewhat modified by I. S. Dunning, City Engineer, for sewers in two districts. The estimated cost is $225,000.

Marquette, Mich.—Contracts for 2,900 ft. of 12-in. trunk and 2,300 ft. 8-in. lateral sewers, 19 manholes and 3 catch basins will soon be let. The Sewer Commissioner is Paul McKey.

Muskegon, Mich.—Plans for a sewerage system have been made by Geo. S. Pierson, of Kalamazoo. John B. Smalley is Chief Engineer.

Duluth, Minn.—Sewers costing $5,000 have been ordered and assessment rolls for the same are filed.

West Denver, Colo.—City Engineer McIntyre has completed specifications for 16¼ miles of vitrified pipe sewers ranging from 8 to 24 ins. in diameter, 5,353 Y branches of various sizes and 284 manholes. The total estimated cost is $122,123.

Salt Lake City, Utah.—Assessment rolls for lateral sewers costing in all $101,000 have been prepared.

Olympia, Wash.—Plans for a sewerage system are being prepared.

Truro, N. S.—Plans have been made by E. H. Keating, of Halifax, and will be voted upon soon.

Roanoke, Va.—The City Council has appointed a special committee to determine the amount of bonds to

be issued for surveying, sewerage and street improvements.

Paving has been ordered in the following cities: Malden, Mass., estimated cost, $6,500; Buffalo, N. Y., German rock asphalt; Newark, N. J., New Orleans, La., gravel; Morgan Park, Ill., macademizing; St. Paul, Minn., grading and cedar block paving; Denver, Colo., gravel roads; Los Angeles, Cal., asphalt.

Buffalo, N. Y.—The Buffalo Paving Co. has secured a small contract for bituminous asphalt pavement at $2.80 per sq. yd. Assessment rolls of 1st quality Medina pavement costing $5,200 have been filed.

New York City.—The Public Works Department has recommended granite block pavement on concrete foundation, and asphalt on the present stone pavement on several streets. The Public Parks Department has recommended for the following year: $236,600 for asphalt walks, $151,300 for street work.

Albany, N. Y.—Asphalt pavement costing $28,875 and granite pavement costing $43,930 have been ordered.

Pennsylvania, Pa.—The Director of Public Works has been authorized to contract for considerable granite, brick and sheet asphalt paving.

Americus, Ga.—The City Council has passed an ordinance providing for paving and sidewalks on a large number of streets.

St. Louis, Mo.—The Board of Public Works has ordered grading, curbing, guttering and Telford paving on several streets.

South Omaha, Neb.—The City Council now has under consideration Colorado sandstone and cedar block paving ordinances, the former amounting to $105,300 and the latter $10,100.

Denver, Colo.—A bill has been passed authorizing a large number of sidewalks. Stone flagging used in their construction must have an area of 8 sq. ft. and be at least 2 ins. thick. Artificial stone may be used.

ELECTRICAL.

Electric Light.—New plants or extensions are proposed at Beuna Vista, Va., by the Loch Laird Land, Estate & Mineral Co.; Florence, Ga., by the Florence Improvement & Manufacturing Co.; Darien, Ga.; Gainesville, Ga., by the Georgia Development Co.; Gainesville, Tex.

Peabody, Mass.—The town has voted $30,000 for an electric light plant and $2,500 for running expenses.

Jamaica, N. Y.—The trustees have contracted with the National Electric Co. to light the town with 32 c. p. lamps at 17.50 per lamp per year.

Atlanta, Ga.—The Atlanta Electric Illuminating Co. has been formally organized with M. H. Atkinson as president and G. R. De Saussaure as secretary. The capital stock of $100,000 has been all taken up and the construction of a plant will begin as soon as possible.

Fernandina, Fla.—F. C. Chase will, it is stated, organize a sub-company of the Safety Electric Light Co., of Boston, Mass., with a capital stock of $100,000, to operate in Fernandina.

Titusville, Fla.—It is said that the Titusville Electric Light Co. wishes prices on a complete 100 incandescent lamp plant, including engines and boilers.

Water Valley, Miss.—The city has voted to issue $10,000 of bonds for the purpose of buying an electric light plant.

Venice, Ill.—The Village Board has given an electric light and power franchise to G. Nieman.

Chicago, Ill.—The Chicago Electric Battery & Power Co. has been incorporated, with a capital stock of $300,000, by G. A. Rollins, D. F. Foley and C. E. Gregory.

Eau Claire Wis.—Negotiations are pending for the purchase of the plants of the Dells Water Power Co., the Brush Electric Light Co. and the Eau Claire Gas Co. by a Maine company, which proposes to consolidate all the concerns under one management.

CONTRACTING.

Sewers.—*Albany, N. Y.*—Prices on a small sewer contract recently advertised were as follows:

18-in. vitrified pipe, per lin. ft.	$3.00	$1.53	$2.18	$3.00	$4.90
15-in. vitrified pipe, per lin. ft.	2.75	95	1.85	3.00	4.75
12-in. vitrified pipe, per lin. ft.	2.50	69	1.62	2.85	4.60
6-in. vitrified pipe, per lin. ft.	60	25	25	50	2.30
18 in. Y branches, each	6.50	3.25	3.85	9.00	8.60
15 in. Y branches, each	5.80	2.25	3.05	8.50	7.90
12-in Y branches, each	5.50	1.95	2.60	8.00	7.40
Manholes, each	70.00	47.50	55.00	50.60	99.60
Lampholes	20.00	10.00	14.00	15.00	75.00
Receiving basins, each	95.00	80.00	95.00	90.00	190.00
3-ft. culvert, per lin. ft.	4.50	1.63	4.00	3.50	6.00

Columbus, O.—Bids on a recent sewer contract were at the following rates: Constructing 3 ring brick sewer, 6 ft. inside diameter, including excavation, materials, filling, etc., complete, $10, $10.44 and $10.65 per ft.; 3 ring, 4½ ft. diam., $6.50, $6.62 and $7 per ft.; 2 ring, 4 ft. diam., $5.58, $5.99 and $6.48 per ft.; 2 ring, 3 ft. diam., $5.25 and $5.40 per ft., 2 ring, 2 ft. diam., $3.70, $3.78 and $4 per ft.; manholes at $12 and $15 per M.; cast iron manhole covers, $8, $8.50 and $13 each.

Paving.—*New York City.*—In making preliminary estimates, the Public Parks Dept. now use the following prices: Ashphalt walk, 25 and 35 cts. per sq. ft.; granite pavement with coal tar and gravel joints, $3.75 per sq. yd.; concrete foundation, $4.50 per cu. yd.; 20 × 6-in. curbing, $1.25 per lin. ft.

Rochester, N. Y.—Recent bids were at the following rates: 2,478 sq. yds. block asphalt, $2.30, $2.64 and $2.67; 2,870 sq. yds. Medina stone, $1.81, $1.82, $1.85 and $2; 2,025 lin. ft. curbstone, 39½, 40, 45 cts. per ft.; 1,312 lin. ft., 40, 42 and 43 cts. per ft.

Buffalo, N. Y.—City Engineer G. E. Mann writes that the cost of paving streets with asphalt is $3 per sq. yd.; with first-class stone, $2.90, and with second class stone, $2.66 per sq. yd.

Oakland, Cal.—Bids for bituminous sidewalks were recently received at the following prices per sq. ft.: 9⅞, 10, 10⅝ and 11 cts.

Birmingham, Ala.—The following bids were recently received for constructing a storm drain, 2⅛ miles long, 12 ft. wide at the bottom, slopes 1 to 1 and an average depth of 7 ft:

	Clearing and grubbing per 100 lin. ft.	Earth excavation, per cu. yd.	Rock excavation, per cu. yd.	Total.
J. Ward & Co.	$2.50	20 cts.	$.85	$15,330
W. H. Hughes	2.75	21½	.89½	16,428
E. Greig	2.50	22½	1.00	17,755
J. J. Cahill	3.50	30	1.40	23,352
J. M. Lovelace	5.00	34	.85	24,330
Munn Bros	4.50	36	1.60	27,804
Henry & Smith	3.00	39	1.40	28,986
McCarthy & Baldwin	5.00	39.9	1.29	29,367

Broken Stone.—*New York City.*—The Dock Department recently received bids for furnishing about 1,000 cu. yds. of broken stone at $1.68, $1.69 and $1.72 per cu. yd.

PROPOSALS OPEN.

Contractor's Railway.—*New York City.*—Materials for building about 1 mile of narrow gauge track, to be delivered at Sandy Hook, N. J., comprising 1 locomotive, 12 dump cars, hoisting and pumping engines, concrete mixers, etc. Lieut.-Col. G. L. Gillespie, Army Building, Oct. 21.

Rip Rap.—*Cleveland, O.*—Constructing about 450 lin. ft. of rip rap foundation for the Cleveland breakwater. Maj. L. Cooper, S. Overen, U. S. Engineer Office, Oct. 16.

Cavalry Drill Hall.—*Fort Riley, Kan.*—A cavalry drill hall, 300 × 100 ft. Separate bids received for the combination truss roof. Capt. G. E. Pond, Oct. 25.

Levee Work.—*Tallulah, La.*—Nearly 1,000,000 cu. yds. divided between 8 separate localities. Levee Commissioners, Oct. 16.

Streets.—*Clifton, O.*—S. G. Sterling, Oct. 25.

St. Louis, Mo.—Grading, curbing and laying Telford pavement on several streets. G. Burnet, Oct. 17.

Denver, Colo.—A large amount of sidewalk work, including some grading. F. B. Crocker, Oct. 24.

Greenbush, N. Y.—Grading, curbing and paving with Belgian blocks. Town Trustees, Oct. 14.

Sewers.—*New York City.*—T. F. Gilroy, Oct. 18.

Denver, Colo.—A large sanitary sewer, including the furnishing of materials for same. F. B. Crocker, Oct 17.

MANUFACTURING AND TECHNICAL.

The Terre Haute Filtering Plant, put in by the National Filter Co., of New York, is now finished and in complete working order, and the *Terre Haute Gazette* pronounces it "the finest plant in the United States," on the authority of Mr. Thomas W. Hooper, the Superintendent of the Davenport, Ia., Water-Works Co. Mr. Davenport has been visiting many large cities in the interest of his company, which will shortly put in a filter plant.

Cars.—The Pullman Palace Car Co. is building in its Detroit shops, 6 chair, 5 baggage and mail cars, 5 Pullman sleepers and 5 passenger coaches for the Chicago, Rock Island & Pacific R. R. The coaches are fitted with Scarritt-Forney seats, and the chair cars with full reclining Scarritt chairs.

Locomotives.—The Schnectady Locomotive Works are reported to be turning out 30 locomotives a month. A ten-wheel compound was recently shipped to the East Tennessee, Virginia & Georgia Ry. The Brooks Locomotive Works have been awarded a contract for building 6 ten-wheel passenger engines for the Atchison, Topeka & Santa Fe R. R. They will have 19 × 26 in. cylinders and 6 3-in. driving wheels. The Baldwin Locomotive Works have an order for two locomotives for the State railway at Cape Town, Africa. This company lately shipped 5 ten-wheel engines to the New York, Pennsylvania & Ohio R. R.

A Small Locomotive is being erected by H. K. Porter & Co. This little engine will have 5 × 10-in. cylinders and 22-in. driving wheels. It is to run on a 23-in. track at the Otis Steel Works, Cleveland.

A Good Running Record.—Passenger locomotive No. 701 on the Indianapolis & Vincennes Division of the Pennsylvania R. R. is reported to have run 122,061 miles without being shopped for repairs.

Locomotive Works.—The Minneapolis & St. Louis Ry. has the walls for extensive locomotive shops partly laid at Minneapolis. They are of brick, one story high and designed especially for rapid repairing. The Brooks Locomotive Works are building a 304 × 65 ft. tank shop at the plant in Dunkirk, N. Y. The greater part of the new building is two stories high, the upper floor being intended for sheet iron and brass finishing rooms.

The Rumford Falls Power Co. has been organized in Portland, Me., for the purpose of developing the water power and building mills at Rumford Falls, Me. The president of the company is G. N. Fletcher, Detroit, Mich.; the secretary, H. J. Chisholm, Portland; the capital stock, $500,000, of which amount $250,000 is reported to be paid up.

A large union depot will probably be built at Bristol, Va., by the Norfolk & Western, East Tennessee, Virginia & Georgia, and South Atlantic & Ohio companies.

The Indiana Steel Co., a new company controlled by Pittsburgh parties, has decided to build its steel works and galvanizing shops at Wabash, in consideration of a gift of $35,000 and 20 acres of land. The company has a capital of $500,000, and will employ about 500 men at the new works, which are designed for a daily output of 50 tons of finished steel.

Van Zile, McCormack & Co., of Albany, are furnishing the material and erecting a 100 × 160 ft. all iron building for the Kimler Mfg. Co., of Newburg, N. Y., to be covered with a corrugated iron roof and 1,000 HP. Heine boilers for the same parties. They are also erecting an all iron building for the Burden Iron Works, of Troy, to be 60 ft. wide by 100 ft. long.

The Fox Pressed Steel Co. will remove its offices from Chicago to Joliet, Ill., where its plant is located.

The Ingersoll-Sergeant Rock Drill Co. of New York, shipped last week a large plant of mining machinery, comprising air compressor, rock drills, etc., to the Jehu Mines in China. Mr. Jonas Crabtree, an experienced mechanical engineer, was engaged by the Ingersoll-Sergeant Co., and is now on his way to China to erect and operate this machinery.

The Standard Paint Co., of New York, has just sold six car-loads of their P. & B. water-proof, acid and alkali resisting paint for use in the St. Clair tunnel. This is the same paint used on the pipes and iron fixtures in the gate-houses on the new Croton Aqueduct.

Troy Engineering Co.—Under this title Messrs. John R. Kaley and P. H. Baermann have opened an office at No. 10 First St., Troy, N. Y. They have 20 years' experience as civil engineers, and announce that they will design, construct or superintend the construction of waterworks, sewerage and public works generally.

New Companies.—Chicago, Ill., Electric Transit Co.; capital stock, $12,000,000; incorporators, J. M. Hannahs, W. H. Powell, G. W. Stanford. Citizens' Gas Co., Center, Ind.; capital stock, $100,000; directors, J. E. Duncan, I. Collins, J. S. Trees and others. Blue Ridge Construction Co., Augusta, Ga.; capital stock, $500,000; incorporators, J. C. Short, New York City; W. Bailey, St. Louis, Mo.; W. E. Jackson, Augusta. Union Street Railway Co., Bay City, Mich.; capital stock, $100,000. Central Car Supply Co., Detroit, Mich.; capital stock, $200,000. Pittsburg, Pa., Malleable Iron Co.; capital stock, $25,000; directors, F. Moore, T. R. McGurley, G. Rollins and others. Illinois Paving & Construction Co., Chicago, Ill.; capital stock, $200,000; incorporators, D. O. Cole, C. B. Pfahler, D. C. Tudor. Cavner Railway Power Transmission Co., Chicago, Ill.; capital stock, ; A. R. Cowner, C. Kennedy, A. A. Tower.

Metal Market Prices.—*Rails*—New York: $30; $25 to $26 for old iron rails. Chicago: $33.50 to $34; old rails, $27 for iron, $18.75 to $22 for steel. Pittsburg: $31 old rails, $27.75 for iron; $20 to $21 for steel.

Foundry Pig-iron.—Chicago: $15.50 to $17.50. Pittsburg: $15.75 to $17.50. New York: $16 to $18.

Track Materials.—New York: steel angle bars, $1.80 to $1.95; spikes, $2.20 to $2.25; track bolts, 2.95 to 3.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.2 cts.; track bolts, 2.9 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 to 2.3 cts. for steel, and 2.15 to 2.2 cts. for iron; spikes, 2.2 to 2.25 cts; iron track bolts $3.10 to $3.15 with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—Chicago, 5.3 to 5.35 cts. New York, 5.25 to 5.75 cts.

Structural Material.—Pittsburg: angles, 2.3 cts.; tees, 2.85 cts.; beams and channels, 3.1 cts.; sheared steel bridge plates, 2.65 to 2.7 cts.; universal mill plates, 2.35 cts.; refined bars, 1.9 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.1 to 3.2 cts. for flange; 2.9 cts. for shell, 2.5 to 2.55 cts. for tank. New York: beams, 3.10 cts.; plates, 2.25 cts.; angles, 2.1 to 2.25 cts.; tees, 2.6 to 2.7 cts.; channels, 3.1 cts. Chicago: angle, 2.35 to 2.4 cts.; tees, 2.9 to 3.0 cts. beams, 3.2 cts.; universal plates, 2.45 to 2.55 cts.

Competitive Bridge Plans.

OFFICE ALLEGHENY BRIDGE CO.,
PITTSBURG, Oct. 6, 1890.

At a meeting of this company, held this day, the following was adopted:

Whereas the plan for the new bridge structure, heretofore adopted by the company, has not proved acceptable to the Secretary of War, and it has become necessary to adopt a new plan; Therefore Resolved, That new plans of the bridge be requested, contemplating not more than two spans, instead of three as heretofore proposed, such plans to be furnished the Board of Managers not later than Nov. 1 proximo. The said new bridge structure not to exceed in cost the sum of five hundred and fifty thousand dollars ($550,000). Resolved, That the sum of $1,000 shall be paid to the engineer whose plan shall be adopted and approved by the company, and that he shall be employed to superintend and direct the construction of the bridge upon such terms and conditions as shall be satisfactory to the company.

41-1t WM. ROSEBURG, Secretary.

PROPOSALS FOR REPAIRS, ETC.—United States Engineer Office, Cleveland, O., Sept. 29, 1890—Sealed proposals, in duplicate, will be received at this office until 12 o'clock M., THURSDAY, OCT. 16, 1890, and then opened, for repairs at Monroe Harbor, Mich.; at Huron Harbor, O.; at Black River Harbor, O. All information can be obtained at this office. The United States reserves the right to reject any or all proposals. Preference will be given to materials and plant of domestic production or manufacture, conditions of quality and price (import duties included) being equal. The attention of bidders is invited to the acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, page 332, and vol. 24, page 414, statutes at large. L. COOPER OVERMAN, Major of Engineers 41-1t

U. S. ENGINEER OFFICE, ROOM 62 ARMY Building, New York, Oct. 1, 1890. Sealed Proposals, in duplicate, will be received at this office until 12 o'clock noon, Tuesday, Oct. 21, 1890, for the purchase of supplies deliverable at Sandy Hook, N. J., comprising materials for building one mile of railroad track; 1 narrow-gauge locomotive; 12 dump cars; 4 dumping coal tubs; 2 hoisting engines; 2 Knowles pressure pumps; 2 cubical concrete mixers; 25 pulley blocks and sheaves, and 2,000 feet wire hoisting rope. The attention of bidders is invited to Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vo . 23, page 332, and vol. 24, page 414, Statutes at Large. For specifications, blank forms, and all information, apply to the undersigned. G. L. GILLESPIE, Lieut. Col. of Engineers. 41-2t

Proposals for Macadam Stone.

Tenders for about 9,000 cubic yards of trap rock, and about 4,000 cubic yards of Granite Macadam Stone, will be received by the Board of Trustees of the Village of Flushing, N. Y., until 8 P. M. Oct. 21, 1890.

Stone to be delivered alongside of dock at Flushing.

Prices to be given by the cubic yard.

The right is reserved to reject any or all bids.

For particulars address

G. A. ROULLIER, Street Commissioner,
41-2t. Flushing, N. Y.

City of Toronto, Canada.

TENDERS FOR PUMPING ENGINES.

Notice is hereby given that the Committee on Water-Works of the municipal corporation of the City of Toronto will receive tenders, addressed to the undersigned, by registered post only, up to the hour of 12 o'clock noon on Monday, Oct. 20, 1890, for two pumping engines of the duplex type, each having a daily capacity of 10,000,000 gallons, together with necessary boilers for same, the whole to be in accordance with the general specifications, which may be obtained at the office of the superintendent of the department, City Hall, Toronto.

The tenders are received subject to the approval of the properly qualified electors being obtained to a by-law providing the necessary funds.

The lowest, or any, tender not necessarily accepted.

WM. J. HILL,
Chairman Committee on Water-Works.
CITY HALL, TORONTO, Sept. 19, 1890.
39-1t

Rushville, Ind., Water-Works.

Sealed proposals will be received by the Common Council of the City of Rushville, Ind., until 12 o'clock M. Nov. 3, 1890, under a franchise to be granted by said city, for the construction of a system of water-works.

A copy of said proposed franchise may be had on application to the Mayor of said city.

Security good for $500 must accompany each bid, either in money, certified check or bond signed by known parties, as a guarantee of good faith, the same to be returned when proposal is rejected or accepted and a satisfactory bond deposited with the Common Council of said city.

The city does not bind itself to accept the lowest or any bid.

WILSON T. JACKSON,
39-2t Mayor.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

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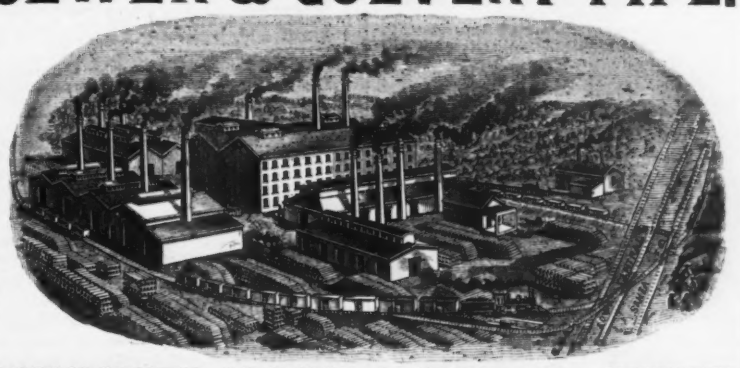

MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

SEA-WALL ON GOVERNOR'S ISLAND, New York Harbor. Engineer Office, U. S. Army, Room 74, Army Building, 39 Whitehall street, New York, N. Y., Oct. 1, 1890. Sealed proposals, in triplicate, will be received at this office until twelve (12) o'clock noon, on Friday, Oct. 31, 1890, for the construction of a Sea-Wall on Governor's Island, New York Harbor. The attention of bidders is invited to Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332 and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. D. C. HOUSTON Colonel of Engineers. 40-4t.

PROPOSALS FOR DREDGING IN SAvannah River, Ga.—United States Engineer Office, Savannah, Ga., Sept. 22, 1890.—Sealed proposals in triplicate will be received at this office until 12 o'clock M., city time, on Oct. 15, 1890, for dredging in Savannah River, Ga. Attention is invited to Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. XXIII., page 332, and Vol. XXIV., page 414, Statutes at Large. For all necessary information apply to O. M. CARTER, First Lieutenant Corps of Engineers, U. S. A. 40-2t

PROPOSALS FOR STONE, MATTRESS and pile work in Savannah Harbor and River, Ga.—United States Engineer Office, Savannah, Ga., Sept. 22, 1890.—Sealed proposals in triplicate will be received at this office until 12 o'clock M., city time, on Oct. 20, 1890, for constructing training walls in the Savannah River, Ga. Attention is invited to Acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, Vol. XXIII., page 332, and Vol. XXIV., page 414. Statutes at Large. For all necessary information apply to O. M. CARTER, First Lieutenant Corps of Engineers, U. S. A. 40-2t

U. S. ENGINEER OFFICE, Room 62, Army Building, New York, Sept. 24, 1890. Sealed proposals in triplicate will be received at this office until 12 o'clock noon, on October 25, 1890, for furnishing materials and constructing a pile wharf at Sandy Hook, N. J. The attention of bidders is invited to Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. For specifications, blank forms and all information, apply to the undersigned.

G. L. GILLESPIE, Lieut. Col. of Engineers. 39-4t

FORT RILEY, KANSAS, Sept. 25, 1890. Sealed proposals in triplicate, subject to usual conditions, will be received here until 3 P. M., Oct. 25, 1890, and then opened, for the construction of a cavalry drill hall 100 × 300 ft. Separate bids will be received for the combination truss roof. Plans and specifications can be seen at this office. The United States reserves the right to reject any or all bids. Envelopes containing proposals should be marked "Proposals for Drill Hall," and addressed to Captain Geo. E. Pond, Assistant Quartermaster, U. S. Army. 40-4t

Belvidere, Ill., Water-Works.

Sealed proposals will be received by the Mayor and Common Coaucil of the city of Belvidere, Ill., until 8 o'clock P. M. on Saturday, Oct. 25, 1890, for the construction of a system of water-works, according to plans and specifications for the same, which may be seen on and after Oct. 8, 1890, at the office of George H. Hurlbut, Chairman of the Fire and Water committee, or at the office of George G. Morgan, 15 Major Block, Chicago.

Each and every proposal must be sealed and marked "Proposal for Water-Works," and must be filed with said George H. Hurlbut on or before the time stated above.

Each and every proposal must be accompanied by a clearing-house check, made payable to the City Treasurer of said city, for the sum of $250, as a guarantee of good faith, the same to be returned to the bidder submitting it, when his proposal is rejected or when accepted, and a satisfactory bond deposited with the said Mayor and Common Council.

The right is reserved to make any additions to or deductions from the materials to be furnished and the work done under the accepted proposal, at a fair price, to the amount of 15 per cent. of the same, at any time before the materials have been ordered or the work done, and the right is still further reserved to reject any and all proposals.

Signed, A. E. JEMER,
41-1t City Clerk.

Becket, Mass.

Bids will be received by the road commissioners until Thursday, Oct. 16, for the bridge near depot, to be 18 ft. between abutments and 20 ft. road, wood railing.

FRED D. BALLOU,
J. A. HUNT,
W. K. HOLMES, } Commissioners.

U. S. ENGINEER OFFICE, 13 W. Saratoga St, Baltimore, Md., Sept. 30, 1890. Proposals for completing the ship channel leading to the harbor at Baltimore will be received until noon of Dec. 2, 1890, and then opened. The attention of bidders is invited to the acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. For information apply to Wm. P. Craighill, Colonel Corps of Engineers, U. S. A. 41-4t.

Notice to Contractors.

Sealed proposals will be received at the office of the Recorder of Albuquerque, New Mexico, until two o'clock P. M., on the first day of November, 1890, for constructing sewers in the town of Albuquerque, Bernalillo Co. New Mexico.

Forms of proposals, copies of specifications and instructions to contractors may be obtained of the Recorder or of the Engineer, and the plans and profiles may be seen at the office of either of the above named parties.

Each bid must be accompanied by a deposit of one thousand dollars ($1,000) as a guarantee of the good faith of the bidder.

The Board of Trustees reserve the right to reject any or all bids.

Address:
HENRY LOCKHART, Recorder,
Albuquerque, N. M.
W. KIERSTED, Engineer,
620 Keith & Perry Building,
Kansas City, Mo.
40-4t.

For Sale---Water-Works.

Located in Central New York, in a fine village of about 2,000 inhabitants. Supply from springs by gravity; everything first class and doing profitable business. Address

WATER-WORKS,
38-4t care of ENGINEERING NEWS.

To Contractors.

I desire bids for the erection of about 100 miles of private telegraph line over a rough mountain country. For particulars address

FRANK MATHEWS,
Chief Engineer K. I. C. & D. Co.,
39-2t Pineville, Ky.

PROPOSALS FOR CONSTRUCTION OF RIP RAP FOUNDATION.—U. S. Engineer office, Cleveland, O., Sept. 29th, 1890. Sealed proposals, in duplicate, will be received at this office until 12 o'clock M. on Thursday, the 16th day of October next, at which time they will be opened in the presence of bidders, for constructing 450 lineal feet, more or less, of rip rap foundation for breakwater at Cleveland, Ohio. All information can be obtained at this office. The United States reserves the right to reject any or all proposals.

Preference will be given to materials and plant of domestic production or manufacture, conditions of quality and price (import duties included) being equal. The attention of bidders is invited to the acts of Congress approved February 26th, 1885, and February 23d, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. L. Cooper Overman, Major of Engineers. 40-2t.

ENGINEER'S

FIELD BOOK

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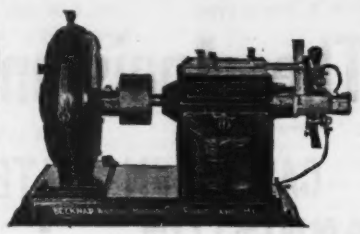

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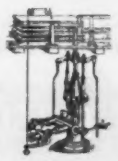

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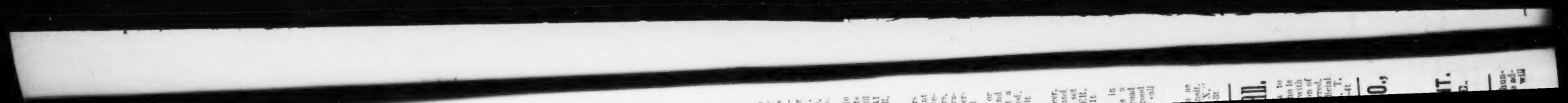
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